REDUCING HIGH FALL RISK MEDICATIONS THAT MAY LEAD TO FALLS

by

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As members of the DNP Project Committee, we certify that we have read the DNP project prepared by *Jayme Lee*, titled *Reducing High Fall Risk Medications That May Lead to Falls* and recommend that it be accepted as fulfilling the DNP project requirement for the Degree of Doctor of Nursing Practice.

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I hereby certify that I have read this DNP project prepared under my direction and recommend that it be accepted as fulfilling the DNP project requirement.

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ABSTRACT

Falls have easily become a growing problem for acute care institutions. Finding a way to reduce the number of falls has become a mystery as many falls are multi-factorial. In order to address this ongoing problem, this study focused on the ordering of medications upon a patient's admission to an acute care facility. A retrospective chart review was completed on the past 30 falls at the Queen's Medical Center. An average of 2.9 high risk medications were found per patient. A pre-test/post-test of an educational intervention was then performed with 10 providers. The intervention gave further education on common high-risk medications. After about 1 week, the next 30 total admissions were reviewed to see how many high-risk medications were ordered. An average of 2.4 high risk medications were found per patient post educational intervention. A paired t-test was used to find the significance between the two variables: Variable A) high fall risk medication prior to admission, and Variable B) high fall risk medications ordered after reading educational handout. Using SPSS, the critical value was found to be 3.396 with alpha at .05 and df = 29. The t-test value was 1.785, which was < 3.396 and the p-value was .085. With the p-value being > 0.05, the two means are not statistically significant. The t-test value is also smaller than the critical value, concluding that the t-statistic of 1.785 is not statistically significant. With these values, it can be concluded that the number of medications ordered were not significantly different after going through the educational session with the handout.

INTRODUCTION

Falls can lead to fall related injuries, and have become a serious problem within acute care facilities (Callis, 2014). Injurious falls have become the most common adverse safety event nationwide in both hospitals and healthcare facilities (Callis, 2014). There are many risk factors connected with inpatient falls including medication, unsteady gait, environmental hazards and alteration in mental status (Callis, 2014). According to The Joint Commission (TJC), falls causing serious injury have been increasing, and about half of the reported falls have led to death (TJC, 2015). TJC has also recognized that most assessment tools take too long to complete and are very difficult to understand (TJC, 2015). Patient falls also affect providers, and have become a large priority for many health care facilities nationwide (Hester, Tsai, Rettiganti, & Mitchell, 2016). By the year 2020, annual fall-related costs are expected to reach $47 billion (Hester et al., 2016). Hospitals have made fall prevention a priority and have shown that it is most effective when using a comprehensive, team-based strategy (Eckstrom et al., 2016).

Background Knowledge

Inpatient falls are the largest category of adverse events in hospitals involving about 1.9% to 3% of all hospitalizations (Hester et al., 2016). Studies show that falls resulting in injury are estimated to be between 6% to 44% in the acute setting (Hester et al., 2016). Of patients who fell, those who had diagnoses affecting more than one bodily system, or a diagnosis of unknown etiology were at a higher risk of injury if he or she fell (Hester et al., 2016). Many times during an admission, a patient is admitted for a primary diagnosis such as nausea or vomiting. Although this patient may have underlying cancer, the treatment is based on nausea and vomiting and the underlying issue is not addressed and therefore, fall risks are not alerted. A patient needs to be

evaluated based upon all diagnoses and history, and not just the admitting reason. Medications should also be ordered based upon the individual as a whole and not just the acute issue. Some medications that are prescribed can actually increase the risk of falls for patients.

At the Queen's Medical Center in Honolulu, Hawai'i, falls have increased over the past years and has resulted in added costs and longer length of stays (The Falls Committee, personal communication, November 13, 2018). There have been preventive measures put in place such as fall risk assessments, however, these tools are often unsuccessful due to their low positive predictive value (Aryee, James, Hunt, & Ryder, 2017).

Initiatives to reduce the number of falls have been examined in order to improve patient safety and care. Falls often result from a complex interaction of risk factors and the more exposure to such risk factors can increase the risk for injurious falls (Park, Satoh, Miki, Urushihara, & Sawada, 2015). Of all these risk factors, medication use is considered to be one of the most important as those who are 65 years and older take more than five medications, which can lead to altered pharmacokinetics and drug toxicities due to polypharmacy (Park et al., 2015).

The purpose of this project is to identify the patients who were on high fall risk medications upon admission to the Queen's Medical Center and then educate providers on these medications in hopes to decrease high fall risk medications ordered and in turn reduce the number of falls while the patient is an inpatient. The aim is to decrease the number of high fall risk medications subsequently decreasing the number of falls by providing medication education to providers. If the patient comes in on multiple high fall risk medications, it is at the provider's discretion to reorder these medications while the patient is in an acute stage of care. Educating providers and giving them more knowledge of high risk medications could prove valuable upon

medication reconciliation and the reduction of inpatient falls. The American Geriatrics Society (AGS) and the British Geriatrics Society (BGS) created guidelines in 2001 for the Prevention of Falls in Older Persons, which has since been updated in 2010 (Appendix A) ('Summary of the Updated,' 2011). The BEERS criteria (Appendix E) also provides a guideline for healthcare professionals to help improve the safety of prescribing medications for older adults (Campanelli, 2012). However, few providers report following these guidelines while in practice (Eckstrom et al., 2016). The BEERS criteria is an extensive list of medications and can often times be overwhelming for providers to search through.

One of the key stakeholders for this project are prescribing providers of the Queen's Medical Center. They will be the main focus since they will be placing the admission orders as well as reviewing the patient's medications, problems and history. The idea of this project is to decrease the ordering of high fall risk medications with the subsequent goal of decreasing falls. At the point of admission, providers have an opportunity to review medications and underlying problems that may place a patient at risk for a fall. Having educated the providers about common high fall risk medications may persuade the provider not to order that certain medication. Providers must be able to keep up with the pace of change within health care in order to meet the demands for better outcomes, cost containment, and better quality of care (Eckstrom et al., 2016).

Patient safety is the responsibility of all health care staff including providers, nurses, aides, therapists, and other staff. Falls prove to be no exception to this idea. Patient falls are widely regarded as a nurse sensitive performance indicator (Hester et al., 2016). However, even providers and policymakers are seeing falls as a priority due to their large impact on

reimbursement from the Centers for Medicare and Medicaid Services (CMS) (Hester et al., 2016). Providers must be aware of patients who are at risk for falls and should take initiative to reconcile medications to avoid patients being on too many medications that may increase risk for falls. Providers act as the technical experts by understanding the process of care and can help with developing a plan and collecting data (Institute for Healthcare Improvement [IHI], 2017). Nurses should be educated on fall risk assessments as well as utilize assessment tools. Because nurses are with patients from morning to night, they serve as the day-to-day leaders who support the project. Nurses are able to see the details of the system and have great input on the effectiveness of changes within the system (IHI, 2017). Lastly, a clinical leader is needed to provide direction and assist with dealing with issues that may arise during an implementation process (IHI, 2017). For this purpose, a provider or management team would be able to fill this role to oversee the team.

Currently at the Queen's Medical Center, the goal for July 2017 – June 2018 was to decrease the number of falls per month to less than or equal to 35.5. The Queen's Medical Center also aimed to reduce the number of major injury falls by 25%. According to the data put out by the falls committee at the Queen's Medical Center, the number of falls have increased since July of 2017. In June 2018, the number of falls for that month totaled 62, which is still greater than the goal of 35.5 falls per month. However, the other months had just missed their mark and averaged about 36 falls per month. Medical-surgical units implemented hourly rounding by the nurses and nurse aides and fall kits during the months of September 2017 and March 2018. Reducing the number of falls at the Queen's Medical Center is still a work in progress and may need a closer look at other factors that could potentially lead to falls. Currently, the falls

committee has not looked at high fall risk medications, so it may be beneficial to take a look at the medications that a patient is prescribed during the hospitalization to see if the problem can be mitigated further.

Project Question

In an inpatient acute care setting on a medical-surgical unit, does educating providers on high fall risk medications affect the way he or she orders medications for patients with the hopes that by decreasing high fall risk medications, falls decrease as well?

THEORETICAL FRAMEWORK AND SYNTHESIS OF EVIDENCE

Theoretical Framework

Evidence-based healthcare is gaining increased acceptance across the nation and is continually expanding and evolving. In order to see how effective educating providers about high fall risk medication can be upon a patient's admission to the hospital, the Joanna Briggs Institute (JBI) model provides a strong framework for evidence-based research. The JBI model was first published in 2005 and explains how evidence-based healthcare is operationalized (Jordan, Lockwood, Aromataris, & Munn, 2016). The model is based on different methods and approaches from work that JBI has reviewed over the preceding years (Pearson, 2005). The JBI model is based on the professional judgement of the health professional, which encourages clinical decision-making that conceptualizes evidence-based care while also taking into consideration the best available evidence, client preference, and the manner in which care is conducted (Pearson, Wiechula, Court, & Lockwood, 2005). There are four main components of this evidence-based healthcare that the JBI addresses and they are as follows: healthcare evidence generation, evidence synthesis, evidence (knowledge transfer), and evidence utilization

(Pearson, Wiechula, Court, & Lockwood, 2005). The achievement of global health is visualized as both the goal and the end-point and is conceptualized as the model components (Pearson, Wiechula, Court, & Lockwood, 2005). The JBI model is represented as a cyclical process that looks at the global healthcare need of clinicians and patients in the ways of deriving questions, concerns or interests. These questions are addressed effectively and appropriately by creating evidence and knowledge (Pearson, Wiechula, Court, & Lockwood, 2005). Next the evidence is appraised, created and transferred to health professionals who carry the intervention out and evaluate its effectiveness on health systems, professional practice, and health outcomes (Pearson, Wiechula, Court, & Lockwood, 2005).

Implementing evidence-based health care is dependent upon valid evidence, synthesis of evidence, transfer of evidence and utilizing evidence (Pearson, 2005). Support for evidence-based practice is found in other tools and resources that are linked to the JBI model (Figure 1) (Pearson, 2005). A tool used to stand alongside the JBI model is the Practical Application of Clinical Evidence Systems (PACES) and consists of an online database that represents a collection of data based on clinical audit processes and a work plan placed online that shows problem identification, action planning, and action taking (Pearson, 2005).

FIGURE 1. JBI model for evidence-based healthcare.

Currently, the JBI model is used in 47 countries but health outcomes and practice improvement has not yet been proven (Pearson, 2005). The Australian Government of Health and Aging has applied this model over a four-year period within its Evidence-Based Clinical Fellow project (Pearson, 2005). Their clinical fellows trained in the JBI model and took it back to their practice area for 22 weeks. After evaluation, the fellows stated they found the model appropriate, relevant, logical and understandable. It was found that the JBI tools played an

important part in creating change in practice (Pearson, 2005). The use of the JBI model has shown significant improvements in evidence-based health care improvements.

The JBI model can be applied to the project question of: 'In an inpatient acute care setting on a medical-surgical unit, does educating providers on high fall risk medications affect the way he or she orders medications for high fall risk patients?' The first step would be to generate evidence by finding research and trials that relate to the current study question. Multiple studies have shown the need for providers to be involved with the reduction of patient falls. Next, synthesizing evidence is needed by evaluating these individual studies. This evidence then needs to be transferred to individual health professionals by way of journals, media, and other education and training (Pearson, Wiechula, Court, & Lockwood, 2005). A combination of education, information, and support systems are needed to present the importance of educating providers on high fall risk medications in hopes to reduce the number ordered upon admission. Finally, the change of more education for prescribing providers will need to be implemented and the attempt to change practice will need to be evaluated. Assessment of the impact, process, and outcome will need to be done so that accurate results can be obtained. Each of these components involves a number of necessary elements on how to effectively implement the intervention of adding medication assessments upon admission.

Barriers can be identified throughout this process of evidence-based change. Placing time and money into a large change cannot always be beneficial if studies are not done to utilize the results that are produced from the intervention (Pearson, Wiechula, Court, & Lockwood, 2005). Implementing any change in the way a provider thinks and does his or her day to day activities such as admission orders can cause disruption and chaos within a hospital environment and

culture. This can prove to be a difficult start for implementing an intervention. Barriers such as staff turnover, lack of readiness for change and stakeholder buy in attribute to some of the hardships for implementation (Eckstrom et al., 2016).

Synthesis of Evidence

The purpose of this DNP project is to educate providers on common high fall risk medications so that he or she may identify these medications upon admission and not reorder these medications at time of admission to the hospital. Searches were performed on PubMed and CINAHL using key words: fall, acute care hospital, inpatient, medication risk, injury. It was attempted to find articles within the past five years, however, it was very difficult to find literature that specifically studied the relationship between medications and fall risks. Therefore, the search was expanded to include the past ten years, 2008-2018. A total of 22 articles were found, however, it was narrowed down to ten articles that fit the project's purpose (Table 1).

Summary of Findings

Common themes were identified within the literature review. Inpatient falls are heavily valued and studied due to the detrimental effects they can have for a patient. Falls occur in approximately 1.9-3% of all acute care hospitalizations and of these falls, 30% of them result in serious injury (Pearson & Coburn, 2011). This nursing-sensitive quality indicator is a high priority for health care organizations and healthcare professionals (Hou et al., 2016). Research has shown that although many fall screening and assessment tools are routinely used within hospitals across the world, the clinical predictability of these tools remains inconclusive due to varying patient characteristics and physical environments (Hou et al., 2016; Yazdani & Hall, 2017; Costa-dias et al., 2013). Falls are costly for the patient and the hospital. They are the

leading cause of death in people aged 65 years or older and 10% of fatal falls occurs within an acute care facility (Pearson & Coburn, 2011). It is evident that fall prevention is a critical component of any patient safety strategy, however, the perfect patient safety culture has yet to be discovered. Finding articles that focused just on medication related fall risks was very difficult due to the small amount of research that has been done in this area. However, two articles did address this issue. A study done by Costa-dias et al. (2013) found that certain medications are associated with a higher fall risk along with higher recurrent fall risks. For example, those who were on psychotropic drugs had a nine-times (9x) higher risk for falls while in an acute care facility (Costa-dias et al., 2013). Antipsychotics showed seven-times (7x) higher risk for falls and five-times (5x) risk for recurrent falls. Antidepressants showed six-times (6x) higher risk for falls and five-times (5x) risk for recurrent falls (Costa-dias et al., 2013). Opioids had a four-times (4x) higher risk for falls and diuretics two-times (2x) higher risk for falls (Costa-dias et al., 2013). A study done by Chiu, Lee, Hwang, Wang, and Lin (2015) took a look at medication related falls as well and found that patients who took tricyclic antidepressants, diuretics and narcotics were 3.36, 1.83, and 2.09 fold, respectively, more likely to experience a fall than patients who were not on these medications. Pharmacological effects of drug therapy place patients at a higher risk for falls while inpatient. These effects include sedation, dizziness, orthostatic hypotension and cognitive changes (Chiu et al., 2015). Polypharmacy or the use of multiple drugs also increase the risk for these adverse drug reactions and increase the risk for falls. One report showed that after medications were adjusted for chronic conditions, the number of prescribed medications were no longer a factor for a predictor of falls, however, another report showed that the association of polypharmacy with the risk of falls still remained a significant

indicator when the medications included at least one medicine that acted on the central nervous system (CNS) or included a diuretic (Chiu et al., 2015).

Strengths, Weaknesses, Gaps and Limitations

Studies show many studies done on falls within the past five years, however, the study of just medication related falls have yet to be studied to its full extent. Pharmacy studies have started to be taken into consideration, however, even with current research and findings, medication related falls and polypharmacy are still great contributions to patient falls within hospitals. Several studies were only able to focus on one hospital and could not generalize the results to other hospitals because of differences in medical treatment, quality of health care providers and characteristics of patients (Chiu et al., 2015). Studies also state that limitations of its study include the inability to predict if fall risk and fall recurrence are a direct result of a drug's therapeutic effect or a consequence of the patient's co-morbidities (Costa-Dias et al., 2014). Other studies that analyzed data using the NDNQI state that participation in this database is voluntary and the hospitals decide which units collect data. Often times, magnet-designated facilities tend to be overrepresented (Staggs, Mion, & Shorr, 2014). This leads to skewed studies and underrepresentation of small hospitals and for-profit hospitals (Staggs, Mion, & Shorr, 2014). Many studies and research show that there is a great need to find a better way to predict and prevent patient falls. John Hopkin's Medical center created a fall risk assessment tool to facilitate early detection of risk for anticipated physiologic falls in adult inpatient units called the John Hopkins Fall Risk Assessment Tool (JHFRAT) (Poe et al., 2018). A study conducted by Poe et al. (2018) found that this tool was reliable in both construct and predictive validity, however, it did not address high risk medications as a risk factor. One of the most popular fall

assessments is known as the Morse Fall Scale (MFS) (Figure 2). It is a simple method of assessing a patient's likelihood of falling and contains six variables that can be easily added up to produce a predictive score (Sardo et al., 2016). Although this scale has been proven to have a high validity, it also does not address high risk medications as a factor for the predictive score that is produced (Sardo et al., 2016). Despite the use of fall assessments, there is a significant gap in knowledge due to falls. Most of this seems to be attributed to the differing patient safety cultures within different facilities. It seems that it is very difficult to do a study comparing more than one acute care facility due to the fact that most hospitals do not follow one pathway of reducing falls and fall risks. A more standardized practice in patient assessment for fall risk factors may be needed to create a way to evaluate these characteristics at a more accurate level.

TABLE 1. *Synthesis of evidence.*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
Chiu et al. (2015). Medication use and fall-risk assessment for falls in an acute care hospital	Examines the relationship between the use of single medications and polypharmacy with falls among hospitalized patients		Case-control study	N=83	Information was taken from patient's charts such as GCS, blood pressure, heart rate, comorbidity, medication use and length of hospital stay. To assess for polypharmacy, all types of daily medications were looked at (stat and regular). All patients admitted were assessed using a 10-item fall-risk scale.	Among older people, fall risks were increased if he or she were on a tricyclic antidepressant or narcotics. Anxiety and polypharmacy both contributed to increased fall risks. Diuretics and beta-blockers did not have much of an effect on fall risk.
Costa-Dias et al. (2013). Medication fall risk in old hospitalized patients: A retrospective study	The objective of this study was to explore the association between medication and falls and the recurrent falls, and identify medication related risk for fall in hospitalized patients in a large acute hospital.		Retrospective and quantitative study	N = 213	The study was conducted through the "face to face consensus" technique. The data analysis was conducted using student's t test, ANOVA, and Odds ratio.	Patients who received psychotropic drugs are nine times more at risk to fall (OR 8.68, $p < 0.05$). Antipsychotics = seven times more at risk to fall (OR 7.27, $p < 0.05$) and also five times more risk of recurrent falls (OR 5.08, $p < 0.05$).

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
						Antidepressants = six times more risk for fall (OR 6.34, $p < 0.05$) and five times more recurrent falls (OR 4.93, $p < 0.05$). Opioid analgesic drugs = 4 times more risk for fall (OR 3.97, $p < 0.05$). Diuretics = twice more recurrent falls (OR 2.37, $p < 0.05$)
Dykes et al. (2010). Fall prevention in acute care hospitals.	The purpose of this study is to evaluate whether a fall prevention tool kit decreases patient falls in hospitals using health information technology (HIT).		Cluster randomized control study	N = 10,264	A stratified, cluster randomization design, with randomized intervention at the unit level within the hospital was used. 3 phases took place. Phase 1 = qualitative injury was used to identify barriers and facilitators to fall risk interventions and communication. Phase 2: prototype of fall prevention tool	There were fewer patients with falls in intervention units (n=67) than in control unit (n=87). The intervention units also had a significantly lower adjusted fall rate (3.15, 95% CI 3.45-5.06) per 1000 patient days with a rate difference of 1.03 (95% CI 0.57-2.01). P =0.04. The

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
					kit (FPTK) by using Morse fall scale risk factors. Phase 3: an iterative process was used to find effective icons to represent fall risk and prevention plan. From these icons, a bed poster, handout and plan of care were created.	FPTK proved to prevent 1 fall per 862 patient days = 1 fall every 4 days, 7.5 falls each month, and about 90 falls each year.
Hou et. al (2016). Evaluation of an inpatient fall risk screening tool to identify the most critical fall risk factors in inpatient	Evaluates accuracy of inpatient fall risk screening tool and attempts to identify most critical fall risk factors		Secondary data analysis	N= 37,437	Application forms to gather required data. Data was checked and frequency was assessed for outliers, incomplete or uncertain data. Inconsistencies were discussed with the primary investigator and then all patient identification was deleted from the data set.	84% of the patients who fell, fell in the absence of family members or relatives. 40.5% of those who fell were rated low risk at admission because of low sensitivity and positive predictive value of the fall risk tool.

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
Marvin et al. (2017). Deprescribing medicines in the acute setting to reduce the risk of falls.	The purpose of this study was to identify if medication review within the hospital setting led to the deprescribing of medications associated with the increased risk of falls.		Retrospective cohort study	N = 100	Discharge summaries were examined to identify patients who suffered from a fall while in the hospital. Evaluation of prescriptions were noted. Final discharge summaries were checked retrospectively to identify documentation of medication reviews and any changes made to current prescriptions. The Kruskal-Wallis test was used to perform descriptive statistics to compare falls-risk medicines before and after review.	86% showed that medication review was documented by either a pharmacist or a doctor. Polypharmacy was revealed in 62% of patients. Of these 62 patients, 57 (98%) were found to have problematic polypharmacy (at least one medication was identified as potentially inappropriate). Polypharmacy was found in more patients upon discharge than at admission. 66% of patients were discharged home from the hospital with polypharmacy.

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
Matsumoto, S., Sato, M., Maeno, T., Ichinohe, Y., & Maeno, R. (2018). Potentially inappropriate medications with polypharmacy increase the risk of falls in older Japanese patients: 1-year prospective cohort study	This study aimed to evaluate if potentially inappropriate medications (PIMs) increase the risk for falls in older Japanese adults while also comparing the difference between patients with and without polypharmacy		Prospective observational cohort study	N = 740	Patients aged 65 years or older were followed for 1 year. A questionnaire revealed medical records, comorbidities and medication prescriptions. PIMs were defined using the Screening Tool of Older Person's Prescriptions criteria version 2. Incidence of falls were compared between patients with and without PIMs. They were divided by those with 5 or more prescriptions and those with fewer than 5 prescriptions.	Potentially inappropriate medications were found in 32.3% of enrolled patients. PIMs were significantly associated with falls in the group with polypharmacy (OR 2.03, 95% CI 1.11-3.69). In the group without polypharmacy no significant association was seen.
Shumba, C., & Abraham, S. (2017). Patient falls in the acute care hospital setting as perceived by the frontline staff	This study aimed to identify contributing factors for patient falls as perceived by acute care staff within the hospital.	Theoretical frameworks used by this study were Maslow's theory of human motivation supplemented by	Quantitative, non-experimental, descriptive study.	N = 148 participants	A cross-sectional design helped the researcher to gather opinions and beliefs of the staff on patient falls. One open ended	Likert-type scale was used to rate each factor (intrinsic/extrinsic). Top factors included confusion

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
		Orlando's theory of nursing process.			question was used to allow staff to explain their feelings and perceptions on patient falls. Research question 1: what are the frontline staffs' perceptions of the intrinsic factors contributing to patient fall sin the acute care hospital setting? RQ2: what are the frontline staffs' perceptions of the extrinsic factors contributing to patient falls in the acute care hospital setting? RQ3: what factors does frontline staff believe contribute to falls on their unit?	(mean=4.51, SD=0.60) unsteady gait (M=4.57, SD=0.56). Use of multiple medications (M=4.06) RQ2: top extrinsic factor was lack of supervision (M=4.69, SD=0.49) and use of teamwork to deter patient falls (M=4.55, SD=4.53). Least extrinsic factor was placing all patients on high fall risk precaution (M=3.03, SD=1.15). RQ3: top 4 intrinsic factors: confusion, medications, unsteady gait, and comorbidities. Top 4 extrinsic factors: need for staffing for patient supervision, lack of safety equipment and

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
						unsafe milieu, lack of teamwork and toileting issues.
Shuto et al., (2009). Medication use as a risk factor for inpatient falls in an acute care hospital: A case-crossover study	This study aimed to evaluate the association between medication use and falls. It looks to identify high risk medication that may act as a trigger for falls within an acute care hospital setting.		Retrospective case-crossover study	N=349	A univariate analysis was performed to select covariates. If a p value was < 0.05, it was considered significantly associated with falls. The evaluation of medication use and falls association was found using odds ratio (OR) and 95% confidence intervals (CI). Medications were divided into 9 groups: hypnotic, anti-anxiety, antipsychotic, antihistamine, antidiabetic, antihypertensive, antiparkinsonian, anti-ulcer agents and diuretics.	The use of antihypertensive, antiparkinsonian, anti-anxiety and hypnotic medications were significantly associated with increased risk for falls. ORs were 8.42, 4.18, 3.25, 2.44 respectively.

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
Staggs, V., Mion, L., & Shorr, R. (2014). Assisted and unassisted falls: Different events, different outcomes, different implications for quality of hospital care	Unassisted falls are more likely to result in injury, however, there is limited research quantifying this to processes of care.		Cross-sectional analysis	N = 166,883	All analyses were carried out using SAS 9.2.	Overall fall rate: 3.44 per 1,000 patient days. 9,259 (5.5%) were repeat falls, 19,607 (12.4%) were assisted and 134,717 (85.5%) as unassisted. There were no difference in average patient age between assisted and unassisted falls. Fallers in units without a fall prevention protocol in place had a higher risk of falling unassisted than those with a protocol in place (95% CI, 1.32,1.46)
Yazdani, C., & Hall, S. (2017). Evaluation of the "medication fall risk score"	This study evaluates the predictive validity of a fall screening tool in hospitalized patients, especially the medication fall		Retrospective cohort study	N=33,058 Patients with falls (n=256) Patients without falls (n=32,802)	Administrative claim data was collected from two urban acute care facilities. Collected information included Morse Fall Scale (MFS),	Incidence of falls 7.74 per 1,000 admissions. Mean +/- S.D. 6.16 +/- 7.37 days. No significant association between

TABLE 1 – *Continued*

Author / Article	Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question	Theoretical Framework	Design	Sample (N)	Data Collection (Instruments/Tools)	Findings
	risk score.				demographics, fall data and medication administration records.	patient sex and fall risk (p=0.601) or age and fall risk (p=0.252). No difference in the incidence of falls between intensive care and general ward patients (6.76 and 7.78 falls per 1,000 admissions respecitively, p=0.570). patients with a fall had a longer length of stay (7 days vs. 3 days; p<0.0001). They used an RxFS(medication fall risk score) to complement the fall-risk screening tool and found that it has not been well studied therefore it had poor discriminatory ability, however, evaluation of medication profiles is a powerful tool that should not be overlooked.

METHODS

Design

This DNP project used a quasi-experimental design study to evaluate whether educating prescribing providers on high fall risk medications reduced the amount that they ordered during admission in a month. Unlike randomized controlled trials, quasi-experimental studies do not use randomization and sometimes lack a control group (Polit & Beck, 2017). For the purpose of this project, a retrospective chart review of 30 falls on a medical-surgical unit was completed to identify if potential high-risk medications were prescribed to these patients upon their admission. The retrospective chart review was performed to measure the frequency of high-risk medications in a patient who suffered a fall at the Queen's Medical Center. This design was appropriate for evaluating the use of high-risk medications in patients and assessing its relationship with patient falls in an acute care institution. For the purpose of this study, a one group, pre-test and post-test was used to gather statistical data to be evaluated, which proved to be appropriate for assessing how an educational intervention affects provider medication reconciliation. A pre/post-test of an educational intervention was performed. The pre-test and post-test had the exact same 10 questions and was given to each participant after the educational intervention (Appendix B). Finally, the charts of the next 30 total admissions of the participants were reviewed to see the frequency of high-risk medications post educational intervention. Before the start of this project, approval was obtained from the Institutional Review Board (IRB) to verify that all steps and processes were accurate to minimize risks and ensure privacy (Polit & Beck, 2017).

Ethical Considerations

Informed consent was performed orally using a script and short form approved by The Queen's Medical Center Research and Institutional Review Committee (RIRC) (Appendix D). Each participant was given a copy of the informed consent summary.

Setting

The setting for this study was at The Queen's Medical Center in Honolulu, Hawai'i, which is the largest and only level 1 trauma center in the Pacific. The organization has attempted to implement different fall prevention and training programs, however, patient falls are still an issue. Despite the efforts of The Queen's Medical Center, the number of falls have still been unable to meet the goal of less than 35.5 falls per month. Current practices include placing high fall risk patients in different colored socks and wristbands. This kit also contains a gait belt for use while a patient is ambulating. Every registered nurse (RN) and certified nursing assistant (CNA) are required to go through a 30-minute in-service to learn the correct way to apply and use a gait belt. The in-service is led by a physical therapist who has been highly trained in the use of gait belts and patient transfers. Therefore, all high fall risk patients must have a gait belt around him or her when ambulating out of bed. All registered nurses must also document a patient's fall risk by using the Morse fall risk assessment tool (Figure 2) each shift. On some units, hourly rounding charts that require signatures from either an RN or CNA are placed in each patient's room to ensure that a staff member are addressing the patient's needs each hour to reduce patients attempts out of bed.

Variables		Score
History of Falling	No Yes	0 25
Secondary Diagnosis	No Yes	0 15
Ambulatory Aid	None/bed rest/nurse assist Crutches/cane/walker Furniture	0 15 30
IV or IV Access	No Yes	0 20
Gait	Normal/bed rest/wheelchair Weak Impaired	0 10 20
Mental status	Oriented to own ability Overestimates or forgets limitations	0 15
	Total	

Morse Falls Score	
High Risk	45 or higher
Moderate Risk	25 - 44
Low Risk	0 - 24

FIGURE 2. Morse fall scale.

The key stakeholders involved during the implementation of this project include prescribing providers and organizational staff. No additional resources or financial costs were needed for this project. Both the pre-test and post-test as well as the educational handout were developed by the researcher (Appendix B & C).

Participants

Participants were recruited from The Queen's Medical Center and were prescribing providers who admit patients to a medical-surgical unit. According to Polit and Beck (2017), those who are most readily available to participate in the study should be selected by convenience sampling. The QMC Falls Committee was asked to identify the most recent 30 patients who previously had a fall before 11-15-18 while at the Queen's Medical Center on any medical-surgical unit. Because hospitalists do most of the admissions to these units, this group was chosen as the main group to look at. The goal was to identify providers who complete the medication reconciliation for patients who are admitted to a medical-surgical unit. Medication reconciliation was found within each patient's electronic medical record. The admitting providers are required to review this list and restart medications he or she feels is necessary for inpatient admission. Admitting providers may also order new medications he or she feels the patient requires while admitted. Healthcare providers were recruited by word of mouth and screened for criteria that included: (a) provider is a hospitalist, (b) provider has ability to do medication reconciliation, and (c) provider has the ability to admit a patient to a medical-surgical unit. It was also important that participants have current patient interaction so he or she understands other potential risks for patient falls. The goal of this project was to have 10 providers who meet the criteria in order to identify change in prescribing patterns.

Data Collection

The first step of this project was a data collection via a retrospective chart review. Some 30 charts were reviewed as they were the most recent falls on medical-surgical units. Mimi Donnelly, from the Falls Committee at the Queen's Medical Center had agreed to provide a list

of the last 30 patients names and MRN who sustained a fall during hospitalization. This list was provided via queens.org email and was not shared with any other entities. The list was kept with the primary investigator in a locked cabinet and remained on the Queen's campus. Patients who were admitted to the Queen's Medical Center due to a fall were excluded. Each chart was looked at and current and prior to admission medications were specifically assessed. Medications were reviewed to see if the patient was on high fall risk medications at home and if they were restarted or if high fall risk medications were started upon admission. High risk medications were identified using the BEERS criteria (Appendix E) and were marked if found within a patient's chart. If any high-risk medications were found prior to admission, the chart was then reviewed to see if the provider continued these medications upon admission. If the provider did indeed continue the high risk medications, these medications will be marked down by the researcher.

The second part of this study focused on the hospitalists. The principal investigator recruited 10 hospitalists who were treating patients on medical-surgical units through personal discussion, and if the hospitalist were interested, the information sheet was provided (Appendix C). A pre-test was then given by the researcher to each participant to assess the provider's knowledge of high fall risk medications (Appendix B). There are six questions on the pre-test with the post-test being the exact same questions. This pre-test/post-test should take about 5-10 minutes depending how long the provider takes to answer. He or she was able to take the hard copy pre-test anywhere on Queen's campus and hand it back in to the researcher. The pre-test and post-test will be linked by the labeling of each set as "Provider 1," "Provider 2," etc. No names were used or recorded. An educational hand out printed on paper was then given to each participant (provider) after completing the pre-test in hopes to provide more knowledge of

common high fall risk medications ordered and re-ordered upon admission to a medical-surgical unit (Appendix C). This handout included information on the most commonly ordered high fall risk medications and the reasoning behind not continuing these types of medications; the researcher then verbally reviewed the handout with hospitalist.

All chart reviews were done on the property of the Queen's Medical Center and only hospital computers were used. No personal laptops or other tablets were used to do the chart reviews. Charts were not printed in order to prevent any breeches of confidentiality for the patient and the provider. The purpose of this project was to identify high fall risk medication, therefore, only the prior to admission medications and the medications ordered at admission were looked at within each chart. Only the primary investigator accessed the charts and reviewed the medications.

The protected health information will not be reused or disclosed to any other person or entity, except as required by law for authorized oversight of this research project. All research associated with the project was destroyed/shredded after completion of the project. Each provider will be listed as 'Provider #1,' 'Provider #2' when data is recorded in order to keep the confidentiality of each provider who was asked to participate in the project.

One week was given to the providers to review the educational handout. After about one week, MRNs were collected of the admissions that were taken. A total of 30 MRNs were received and reviewed for prior to admission medications as well as medications restarted by the provider.

Data Analysis

After performing the retrospective chart review on the 30 patients who fell at the Queen's Medical Center, the mean average of high-risk medications ordered was 2.9. This means that each patient was on approximately three high-risk fall medications when they suffered a fall at the Queen's Medical Center. The pre-test and post-test were scored out of 10 points, one point for each question. There was no difference in the participant's pre-test and post-test scores. Each post-test score for each participant was the same as his or her pre-test score (Appendix H).

Lastly, the 30 charts after educational intervention were reviewed and medication reconciliation was looked at to see if a change in high-risk fall medications could be seen. A mean of 2.4 high-fall risk medications was calculated, showing that each patient was still on 2-3 high-risk fall medications. It was found that there was a slight decrease in high fall risk medications, however, 84% of the time, high fall risk medications were still being ordered. The number of times high fall risk medications were restarted upon admission were lower by an average of 0.5 medications post educational handout. A paired t-test was used to find the significance between the two variables: Variable A) high fall risk medication prior to admission and Variable B) high fall risk medications ordered after reading educational handout. Using SPSS, the critical value was found to be 3.396 with alpha at .05 and df = 29. The t-test value was 1.785, which was < 3.396 and the p-value was .085. With the p-value being > 0.05, the two means are not statistically significant. The t-test value is also smaller than the critical value, concluding that the t-statistic of 1.785 is not statistically significant. With these values, it can be concluded that the number of medications ordered were not significantly different after going through the educational session with the handout (Appendix G).

DISCUSSION

Upon completion of this project, no statistical significance was found after the educational intervention. Although the results were found to not be statistically significant, it was seen on the retrospective chart review that there were two patients on as many as seven high-risk medications, one patient was on six high-risk medications, and two patients were on five high-risk medications. After the educational intervention there were zero patients on six or seven high-risk medications and only one patient was still on five high-risk medications. Even though the average means remained close in number, it is important to point out that the range of high-risk medications post educational intervention did decrease.

Many studies have been conducted on falls in the elderly population within the community and long-term care facilities, however, less is known about falls within acute care settings (Shuto et al., 2009). Many of the observational studies performed on falls in hospitals fail to include medication use as a risk factor for falls because the majority of falls are multi-factorial within an acute care setting (Shuto et al., 2009). In the study performed by Shuto et al. (2009), which states it is the first case-crossover study to evaluate the association between medication use and falls, found that medications that act directly on the central nervous system are significantly associated with an increased risk in falls. Unfortunately, this study did not address the number of medications each patient was on as well as no educational intervention was included.

In another study done by Cashin and Yang (2011), they found 151 patients experienced a fall within a year and of those, 144 patients were taking at least one high-risk medication. The mean number high-risk medications per patient who experienced a fall was 2.2 (Cashin & Yang,

2011). This mean is 0.7 or approximately one medication less than what was found at the Queen's Medical Center. Of the falls documented, most of the high-risk medications had been started 24 hours to seven days before the fall (Cashin & Yang, 2011). Even after educational intervention, the mean was 2.4, which was still 0.2 above the Cashin & Yang (2011) study.

There are many classes of medications associated with falling, so even with a strict criteria established for "high-risk" medications, this presents with a long list of medications that providers would need to avoid. An alert within the electronic health record that pops up when a provider orders a high-risk medication could assist with decreasing the number of medications ordered. A visual alert may allow providers to see exactly how many high-risk medications a patient is on.

There were some limitations within this study. Due to the time constraints of this study, only 30 falls at the Queen's Medical Center were able to be looked at. A deeper look into more retrospective charts as well as classes of medications may increase the accuracy of a study of this nature. The study did not take in to account if increased census was current at the time. Also, the only participants that were educated were the 10 providers. Other providers who were included in the patient's case such as cross-cover providers were not included in the educational intervention. This study only looked at how many medications a patient who had fallen was on. It did not include a medication administration study, meaning the patient who fell may have never taken the high fall risk medication at all. There have not been studies on patients being at higher risk of falling if he or she was on more than one high-risk medication, however, expert opinion suggests that the lowest possible effective dose be used as well as any unnecessary medications be removed from a patient's regimen (Cashin & Yang, 2011).

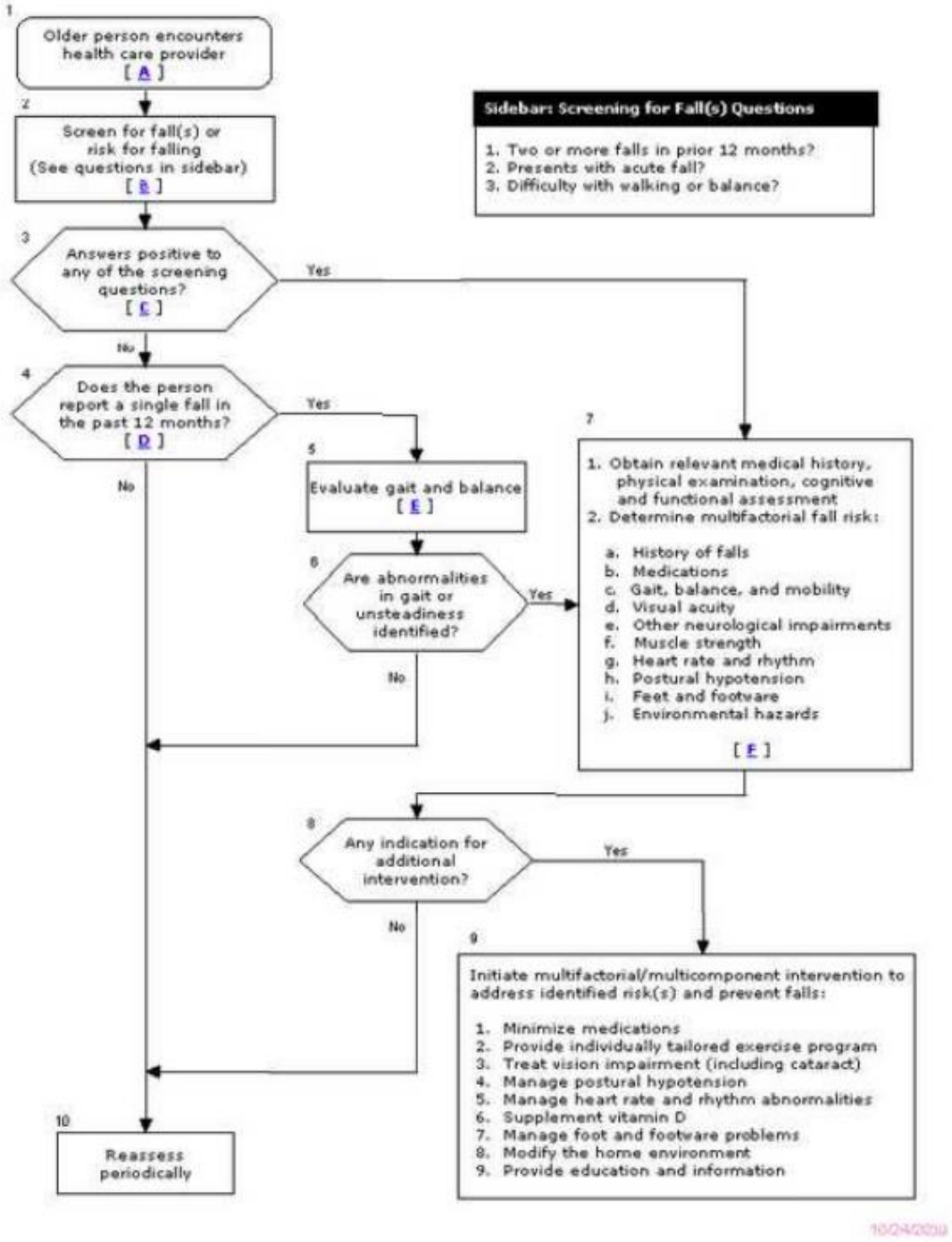
Overall, the study showed a slight decrease in high-risk medications being ordered after the educational intervention, however, not a statistically significant decrease. It may be beneficial if the classes and specific names of medications were provided next time so that providers had exact medications to be aware of. Many of the studies identified in the literature address only geriatric patients, however, age was not included in this study and could be addressed in the future. Another limitation was that no other disciplines were involved such as nursing or pharmacy. These groups could prove beneficial in the future for assistance with monitoring and measuring.

Conclusion

Many medications have been associated with falls, and this study showed that almost every patient who experienced a fall was on at least one of these medications. Given that falls can lead to increased morbidity and mortality, a multidisciplinary fall prevention strategy is warranted including a thorough review of patients' medication upon admission to assess the risk of falling. Appropriate preventive strategies such as a comprehensive review of medications and continued education for providers should be considered to increase quality of patient care and safety.

APPENDIX A:

PREVENTION OF FALLS IN OLDER PERSONS


1
Older person encounters health care provider
[A]
2
Screen for fall(s) or risk for falling
(See questions in sidebar)
[B]
Sidebar: Screening for Fall(s) Questions
1. Two or more falls in prior 12 months?
2. Presents with acute fall?
3. Difficulty with walking or balance?
3
Answers positive to any of the screening questions?
[C]
Yes
No
4
Does the person report a single fall in the past 12 months?
[D]
Yes
No
5
Evaluate gait and balance
[E]
6
Are abnormalities in gait or unsteadiness identified?
Yes
No
7
1. Obtain relevant medical history, physical examination, cognitive and functional assessment
2. Determine multifactorial fall risk:
a. History of falls
b. Medications
c. Gait, balance, and mobility
d. Visual acuity
e. Other neurological impairments
f. Muscle strength
g. Heart rate and rhythm
h. Postural hypotension
i. Feet and footware
j. Environmental hazards
[F]
8
Any indication for additional intervention?
Yes
No
9
Initiate multifactorial/multicomponent intervention to address identified risk(s) and prevent falls:
1. Minimize medications
2. Provide individually tailored exercise program
3. Treat vision impairment (including cataract)
4. Manage postural hypotension
5. Manage heart rate and rhythm abnormalities
6. Supplement vitamin D
7. Manage foot and footware problems
8. Modify the home environment
9. Provide education and information
10
Reassess periodically
10/24/2010

APPENDIX B:

PRE-TEST/POST-TEST QUESTIONS FOR PROVIDERS

Pre-Test and Post-Test Questions for Providers

1. Please state occupation (i.e., MD, DO, NP, CNS, etc.)

   _____

2. How many years have you been practicing at the Queen's Medical Center?

   _____

3. Did you work at another acute care facility prior to the Queen's Medical Center?

   YES NO

4. Do you have knowledge of the Fall Prevention for Older Adults guidelines put forth by the American Geriatrics Society and the British Geriatrics Society?

   YES NO

5. Do you have knowledge of the BEERS criteria for potentially inappropriate medications for older adults?

   YES NO

6. From the list of medications, please circle all that should be avoided due to the high risk for falls it poses to patients

   a. Antipsychotics
   b. Narcotics
   c. Antidepressants
   d. Anticholinergics
   e. Cardiac medications
   f. Laxatives

APPENDIX C:

EDUCATIONAL HANDOUT ON HIGH RISK MEDICATIONS

WHAT ARE WE ORDERING FOR OUR PATIENTS?

- If a patient has a history of falls or fractures, AVOID ordering opioids
- Antidepressants/Antipsychotics/Benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics/opioid receptor agonist analgesics should be evaluated upon admission.
    - Greater than or equal to 2 or more central nervous system (CNS) -active drugs places the patient for an INCREASED RISK OF FALLS
    - Avoid greater than or equal to 3 CNS active drugs
- Antipsychotics should be avoided as the first-line treatment of delirium due to the potential for adverse drug reactions.
    - Try non-pharmacological interventions FIRST
        - Nonpharmacological strategies for hospitalized older adults can be accessed online at www.hospitalelderlifeprogram.org (AGS, 2015).
            - 11 of 14 studies demonstrated significant reductions in delirium incidence and a decrease in the rate of falls using these strategies (AGS, 2015).
    - Only order if the patient is at a substantial risk to harming themselves or others
- Hypertension – avoid ordering peripheral alpha – 1 blockers such as Doxazosin, Prazosin, Terazosin due to its side effect of orthostatic hypotension = HIGH RISK FOR FALLS
- AVOID ordering benzodiazepines (ie. Alprazolam, Lorazepam, Diazepam, Zolpidem etc.)

    - Older adults have increased sensitivity to these medications and decreased metabolism for long-acting agents.
    - Increased risk for cognitive impairment, falls, fractures and delirium
- CNS and analgesics – review medications and reduce dosages if the patient requires these drugs
    - If creatinine clearance is < 60
        - Gabapentin, Levetiracetam, and Pregabalin– reduce dosage
    - If creatinine clearance is < 30
        - Tramadol – reduce dosage
- Cimetidine, Famotidine, Ranitidine dosages should be reduced if creatinine clearance is < 50 due to its effect of mental status changes = HIGH RISK FOR FALLS

Queen's offers additional resources to assist with reducing high fall risk medications:

• Geriatrics team available

• UpToDate

APPENDIX D:

INFORMED CONSENT SUMMARY

Study Information Summary

Study Title: Reducing High Risk Medications That May Lead to Falls
Principal Investigator: Jayme N. Lee, RN, DNP student
Contact information: (808) 291-2557, jaylee@queens.org

You are being asked to participate in the study because one of your patients has suffered a fall during their inpatient stay in a medical-surgical unit during the period of time January 2018 – 11-15-18. You will be one of 10 hospitalists involved in this study.

Identifying fall risk medications is an important element to reducing falls within the Queen's Medical Center. By participating in this study, you will be asked to:

- Answer a pre-test to assess medication knowledge.
- You will then be given an educational handout on high fall risk medications that you may review for one week.
- After this 1 week, you will let the researcher know which patients you've admitted on a daily basis by writing last name and MRN of patient on a sheet and either leaving in a box on the unit or handing directly to researcher (for a total of 30 patients among all 10 hospitalists)
- A post-test will then be given to you. This post-test will have the same questions as the pre-test.

Your name will not be included in this study or be placed on the pre-test or post-test. Each participant will be labeled as Provider 1, Provider 2, etc. At any time during this study, you may withdraw if you decide you do not want to participate any more. This study will last about a month, however, you are not required to do anything but fill out the questionnaires and read the educational hand out.

For the purpose of this study, I will be reviewing your ordering of medications after the educational hand out is given. No names will be produced in the final publication of this study and no one else will have access to the information of this study. No expenses are required and you will have no responsibility except your normal duties to your patients. With the information obtained, the hope is to reduce the amount of high risk medications ordered upon admission to reduce the number of falls seen at the Queen's Medical Center.

Thank you for again for agreeing to participate in this study.

If you have any questions about this study, please contact Jayme Lee at (808) 291-2557 OR you may contact The Queen's Medical Center Research and Institutional Review Committee (RIRC) at 808-691-4512.

APPENDIX E:

BEERS CRITERIA

CLINICAL INVESTIGATIONS

American Geriatrics Society 2015 Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

By the American Geriatrics Society 2015 Beers Criteria Update Expert Panel

The 2015 American Geriatrics Society (AGS) Beers Criteria are presented. Like the 2012 AGS Beers Criteria, they include lists of potentially inappropriate medications to be avoided in older adults. New to the criteria are lists of select drugs that should be avoided or have their dose adjusted based on the individual's kidney function and select drug–drug interactions documented to be associated with harms in older adults. The specific aim was to have a 13-member interdisciplinary panel of experts in geriatric care and pharmacotherapy update the 2012 AGS Beers Criteria using a modified Delphi method to systematically review and grade the evidence and reach a consensus on each existing and new criterion. The process followed an evidence-based approach using Institute of Medicine standards. The 2015 AGS Beers Criteria are applicable to all older adults with the exclusion of those in palliative and hospice care. Careful application of the criteria by health professionals, consumers, payors, and health systems should lead to closer monitoring of drug use in older adults. **J Am Geriatr Soc 63:2227–2246, 2015.**

Key words: Beers List; medications; Beers Criteria; drugs; older adults; polypharmacy

The American Geriatrics Society (AGS) Beers Criteria for Potentially Inappropriate Medication (PIM) Use in Older Adults is an explicit list of PIMs best avoided in older adults in general and in those with certain diseases or syndromes, prescribed at reduced dosage or with caution or carefully monitored. Beers Criteria PIMs have been found to be associated with poor health outcomes, including confusion, falls, and mortality.[1,2] Avoiding PIMs in older adults is one strategy to decrease the risk of adverse events. Interventions using explicit criteria have been found to be an important component of strategies for reducing inappropriate medication usage.[3–5]

The AGS Beers Criteria for PIM Use in Older Adults are one of the most frequently consulted sources about the safety of prescribing medications for older adults. The AGS Beers Criteria are used widely in geriatric clinical care, education, and research and in development of quality indicators. In 2011, the AGS assumed the responsibility of updating and maintaining the Beers Criteria and, in 2012, released the first update of the criteria since 2003. The AGS has made a commitment to update the criteria regularly. The changes in the 2015 update are not as extensive as those of the previous update, but in addition to updating existing criteria, two major components have been added: 1) drugs for which dose adjustment is required based on kidney function and 2) drug–drug interactions. Neither of these new additions is intended to be comprehensive, because such lists would be too extensive. An interdisciplinary expert panel focused on those drugs and drug–drug interactions for which there is evidence in older adults that they are at risk of serious harm if the dose is not adjusted or the drug interaction is overlooked.

OBJECTIVES

The specific aim was to update the 2012 AGS Beers Criteria using a comprehensive, systematic review and grading of the evidence on drug-related problems and adverse drug events in older adults. The strategies to achieve this aim were to:

- Incorporate new evidence on currently listed PIMs and evidence from new medications or conditions not addressed in the 2012 update.
- Incorporate two new areas of evidence on drug–drug interactions and dose adjustments based on kidney function for select medications.
- Grade the strength and quality of each PIM statement based on the level of evidence and strength of recommendation.
- Convene an interdisciplinary panel of 13 experts in geriatric care and pharmacotherapy who would apply a modified Delphi method to the systematic review and

From the Special Projects & Governance, American Geriatrics Society, New York, New York.

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grading to reach consensus on the updated 2015 AGS Beers Criteria.
- Incorporate needed exceptions in the criteria as the panel deemed clinically appropriate. These exceptions would be designed to make the criteria more individualized to clinical practice and be more relevant across settings of care.

INTENT OF CRITERIA

The primary target audience for the AGS Beers Criteria is practicing clinicians. The criteria are intended for use in all ambulatory, acute, and institutionalized settings of care for populations aged 65 and older in the United States, with the exception of hospice and palliative care. Consumers, researchers, pharmacy benefits managers, regulators, and policymakers also widely use the AGS Beers Criteria. The intentions of the criteria are to: improve medication selection; educate clinicians and patients; reduce adverse drug events; and serve as a tool for evaluating quality of care, cost, and patterns of drug use of older adults.

The goal of the 2015 AGS Beers Criteria continues to be improving the care of older adults by reducing their exposure to PIMs. This is accomplished by using the criteria as an educational tool and quality measure—two uses that are not always in agreement. These criteria are not meant to be applied in a punitive manner. Prescribing decisions are not always clear-cut, and clinicians must consider multiple factors, including discontinuation of medications no longer indicated. Quality measures must be clearly defined, easily applied, and measured with limited information and thus, although useful, cannot perfectly distinguish appropriate from inappropriate care. The panel considered and vigorously discussed both roles during deliberations. The panel's review of evidence at times identified subgroups of individuals who should be exempt from a given criterion or to whom a specific criterion should apply. Such a criterion may not be easily applied as a quality measure, particularly when such subgroups cannot be easily identified through structured and readily accessible electronic health data. In these cases, the panel felt that a criterion should not be expanded to include all adults aged 65 and older when only certain subgroups have an adverse balance of benefits versus harms for the medication or conversely may be appropriate candidates for a medication that is otherwise problematic.

Despite past and current efforts to translate the criteria into practice, some controversy and myths about their use in practice and policy continue to prevail. The panel addressed these concerns and myths by writing a companion piece to the updated criteria to address the best way for patients, providers, and health systems to use (and not use) the 2015 AGS Beers Criteria. Alternative suggestions to medications included in the current Use of High-Risk Medications in the Elderly and Potentially Harmful Drug-Disease Interactions in the Elderly quality measures are presented in another companion paper. Both papers will be published online in this journal.

METHODS

For this new update, the AGS employed a well-tested framework that has long been used for development of clinical practice guidelines.[6,7] Specifically, the framework involved the appointment of a 13-member interdisciplinary expert panel with relevant clinical expertise and experience and an understanding of how the criteria have been previously used. This framework also involved a development process that included a systematic literature review and evaluation of the evidence base by the expert panel. Finally, the Institute of Medicine's 2011 report on developing practice guidelines, which included a period for public comments, guided the framework. These three framework principles are described in greater detail below.

PANEL SELECTION

A panel with expertise in geriatric medicine, nursing, pharmacy practice, research, and quality measures was convened comprising members of the previous panel and new members. Other factors that influenced selection of panel members were the desire to have interdisciplinary representation, a range of medical expertise, and representation from different practice settings (e.g., long-term care, ambulatory care, geriatric mental health, palliative care and hospice). In addition to the 13-member panel, representatives from the Centers for Medicare and Medicaid Services, National Committee for Quality Assurance, and Pharmacy Quality Alliance were invited to serve as ex-officio members.

Each expert panel member completed a disclosure form at the beginning of the guideline process that was shared with the entire panel at the start of each panel meeting and call. Panel members who disclosed affiliations or financial interests with commercial entities are listed in the disclosures section of this article. Panel members were asked to recuse themselves from discussions if they had a potential conflict of interest.

LITERATURE SEARCH

The literature from August 1, 2011 (the end of the previous panel's search) to July 1, 2014, was searched to identify published systematic reviews, meta-analyses, randomized controlled trials, and observational studies that were relevant to the project. The initial literature search was conducted on PubMed and the Cochrane Library. The drugs, drug classes, and conditions included in the 2012 criteria were used as initial search terms and were generally focused on "adverse drug events" and "adverse drug reactions." Individual drugs, drug classes, and conditions were searched individually and in combination. Search filters included human subjects, English language, and aged 65 and older. Case reports, case series, editorials, and letters were excluded. Clinical reviews were included for initial screening as potential background information and for reference list review. The initial searches identified 20,748 citations, of which 6,719 were selected for preliminary abstract review. The panel co-chairs reviewed 3,387 citations and abstracts, of which 2,199 were excluded for not meeting the study purpose or not containing primary data. At the time of the panel's face-to-face meeting, the co-chairs had selected 1,188 unduplicated citations for the full panel review. Subsequent searches (defined by panel workgroups) were conducted until December 15, 2014;

some of these searches included studies published in the prior 10 years. The AGS also gave its members and members of the public a chance to submit evidence they felt the panel should consider. Any evidence submitted had to be evidence based and published in a peer-reviewed journal. Panel members reviewed abstracts, and evidence tables were developed for 342 studies, including 60 systematic reviews and meta-analyses, 49 randomized controlled trials, and 233 observational and other types of publications.

DEVELOPMENT PROCESS

Since the previous update, the AGS had created a group to monitor the literature and to advise the 2015 expert panel of any articles relevant to the 2012 criteria and respond accordingly. Two members of the expert panel (MS, SL) led this group, which was composed of members of the AGS Clinical Practice Committee and other expert members of AGS. The 2015 expert panel convened for a 2-day in-person meeting on July 28–29, 2014, to review the groups' findings and the results of the literature search. Panel discussions were used to define terms and to address questions of consistency, inclusion of infrequently used drugs, strategies for evaluating the evidence, consolidation or expansion of individual criterion, and development of renal dosage and drug–drug interaction tables. The panel then split into four groups, with each assigned a specific set of criteria for evaluation. Groups were assigned as closely as possible according to specific area of clinical expertise (e.g., cardiovascular, central nervous system). Groups reviewed the literature search, selected citations relevant to their assigned criteria, and determined which citations they wanted to see the full-text article for and which should be abstracted into an evidence table. The groups then presented their findings to the full panel for comment and consensus. After the meeting, each group participated in a series of conference calls to continue the literature selection process and resolve any questions.

An independent researcher led the effort to prepare evidence tables and relied on the assistance of one other researcher for the initial drafts of evidence tables. The evidence tables included a summary of the study, as well as a quality rating and rating of the risk of bias for selected articles. The quality rating system was based on the Cochrane Risk of Bias[8] and Jadad scoring system.[9] The ratings were based on six critical elements: evidence of balanced allocation, allocation concealment, blinded outcome assessment, completeness of outcome data, selective outcome reporting, and other sources of bias. Following the Cochrane approach, each article was assigned a quality score (1–6 points) and a risk-of-bias rating. Low risk of bias was indicated by a low risk of bias in all six domains, unclear risk of bias was indicated by an unclear rating on one or more domains (others low) or a high risk of bias on one domain (others low or unclear), and high risk of bias was indicated by a high risk of bias on two or more domains. The independent researcher reviewed all evidence tables and proposed quality and risk-of-bias ratings before they were distributed to the expert panel to use for the Grades of Recommendation Assessment, Development, and Evaluation[10] (GRADE) rating process.

Each panelist independently rated the quality of evidence and strength of recommendation for each criterion using the American College of Physicians' Guideline Grading System[11] (Table 1), which is based on the GRADE scheme developed previously. AGS staff compiled the panelist ratings for each group and returned them to that group, which then reached consensus in a conference call. Additional literature was obtained and included as needed. When group consensus could not be reached, the full panel reviewed the ratings and worked through any differences until consensus was reached. The panel judged each criterion as being a strong or weak recommendation on the basis of the quality of supporting evidence, the frequency and severity of harms, and the availability of better treatment alternatives. For some criteria, the panel provided a "strong" recommendation, even though the quality of evidence was low or moderate, when the potential for harm was substantial and safer or more-effective alternatives were available.

After consensus was reached within the expert panel, the updated guidelines were circulated for peer review to relevant organizations and societies and posted to the AGS website for public comment. Organizations that participated in peer review are listed in the Acknowledgments section of this article. The panel reviewed and addressed all comments.

Table 1. Designations of Quality of Evidence and Strength of Recommendations

Quality of Evidence	
High	Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes (≥2 consistent, higher-quality randomized controlled trials or multiple, consistent observational studies with no significant methodological flaws showing large effects)
Moderate	Evidence is sufficient to determine risks of adverse outcomes, but the number, quality, size, or consistency of included studies; generalizability to routine practice; or indirect nature of the evidence on health outcomes (≥1 higher-quality trial with >100 participants; ≥2 higher-quality trials with some inconsistency; ≥2 consistent, lower-quality trials; or multiple, consistent observational studies with no significant methodological flaws showing at least moderate effects) limits the strength of the evidence
Low	Evidence is insufficient to assess harms or risks in health outcomes because of limited number or power of studies, large and unexplained inconsistency between higher-quality studies, important flaws in study design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes
Strength of Recommendation	
Strong	Benefits clearly outweigh harms, adverse events, and risks, or harms, adverse events, and risks clearly outweigh benefits
Weak	Benefits may not outweigh harms, adverse events, and risks
Insufficient	Evidence inadequate to determine net harms, adverse events, and risks

Adapted from[11].

RESULTS

The panel's recommendations are presented in Tables 2–7. References, as evidence tables, supporting the recommendations appear in the online appendix posted on the AGS website (www.americangeriatrics.org). Consistent with the 2012 AGS Beers Criteria, Tables 2–4 list PIMS for older adults outside the palliative care and hospice setting, including medications to avoid for many or most older adults (Table 2); medications for older adults with specific diseases or syndromes to avoid (Table 3); and medications to be used with caution (Table 4). New to the AGS Beers Criteria are potentially clinically important non-anti-infective drug–drug interactions (Table 5) and non-anti-infective medications to avoid or the dosage of which should be adjusted based on the individual's kidney function (Table 6). Tables 8-10 document the differences between the 2012 and 2015 AGS Beers Criteria.

Noteworthy Changes to PIMs and Older Adults

Based on two retrospective studies, the recommendation to avoid the anti-infective nitrofurantoin in individuals with a creatinine clearance of less than 60 mL/min has been revised, given evidence that it can be used with relative safety and efficacy in individuals with a creatinine clearance of 30 mL/min or greater. The long-term use of nitrofurantoin for suppression should still be avoided because of concerns of irreversible pulmonary fibrosis, liver toxicity, and peripheral neuropathy (Table 2).

The recommendation to avoid antiarrhythmic drugs (Classes 1a, 1c, III) as first-line treatment for atrial fibrillation has been removed in light of new evidence and guidelines that suggest that rhythm control can have outcomes as good as or better than those with rate control. Nevertheless, certain antiarrhythmics remain in the criteria. Amiodarone is still to be avoided as first-line therapy for atrial fibrillation unless the individual has heart failure or substantial left ventricular hypertrophy. Dronedarone is to be avoided in individuals with permanent atrial fibrillation or with severe or recently decompensated heart failure. Disopyramide, a Class 1a antiarrhythmic drug, should also be avoided because it is highly anticholinergic. Digoxin should be avoided as first-line therapy for atrial fibrillation or heart failure and should not be prescribed in daily doses greater than 0.125 mg for any indication.

The nonbenzodiazepine, benzodiazepine receptor agonist hypnotics (eszopiclone, zaleplon, zolpidem) are to be avoided without consideration of duration of use because of their association with harms balanced with their minimal efficacy in treating insomnia. The recommendation to avoid sliding-scale insulin is retained, and further clarification of what constitutes a sliding-scale regimen is provided. An addition to Table 2 is the avoidance of the use of proton-pump inhibitors beyond 8 weeks without justification. Multiple studies and five systematic reviews and meta-analyses support an association between proton-pump inhibitor exposure and *Clostridium difficile* infection, bone loss, and fractures. Desmopressin for the treatment of nocturia or nocturnal polyuria is another addition because of the high risk of hyponatremia.

Noteworthy Changes to Drug–Disease and Drug–Syndrome PIMS

The nonbenzodiazepine, benzodiazepine receptor agonist hypnotics have been added to the list of drugs to avoid in individuals with dementia or cognitive impairment. Opioids have been added to the list of central nervous system (CNS) medications that should be avoided in individuals with a history of falls or fractures. Antipsychotics are to be avoided as first-line treatment of delirium because of conflicting evidence on their effectiveness and the potential for adverse drug effects (Table 3).

Drugs to Be Used with Caution

Table 4, medications to be used with caution in older adults, has not been changed. The panel determined that the medications listed in this table did not rise to the level of meriting inclusion in Tables 2 and 3 and should not be considered key elements of the criteria. Nevertheless, the panel believed that there was sufficient uncertainty or concern about the balance of benefits and harms for the listed medications that clinicians should be aware of potential problems and exercise caution when considering their use.

Drug–Drug Interactions

New to the AGS Beers Criteria are drug–drug interactions (excluding anti-infectives) that are highly associated with harmful outcomes in older adults.[12] The list is selective, and not comprehensive, and is not intended to diminish the clinical importance of known drug–drug interactions not listed. Examples of drug–drug interactions included in this new section include peripheral alpha-1 blockers used in combination with loop diuretics, which increases the risk of urinary incontinence in women, and taking three or more CNS-active drugs concomitantly, which increases the risk of falls. Other interactions manifest as extensions of both drugs' known pharmacological effects (e.g., angiotensin-converting enzyme inhibitors (ACEIs) and potassium-sparing diuretics without indications for use in systolic heart failure (amiloride and triamterene), which together increase risk of hyperkalemia). Other interactions increase the risk of a drug's toxicity (e.g., lithium in combination with an ACEI or loop diuretics) (Table 5).

PIMs Based on Kidney Function

Also new for 2015 are drugs that should be avoided or for which the dose should be adjusted in individuals with a specific degree of kidney impairment to avoid harm. This list was adapted from published consensus guidelines that an expert group including two AGS Beers Criteria panelists developed.[13] The AGS Beers panel reviewed the evidence and selected medications from these earlier consensus guidelines for inclusion; added additional medications, including several anticoagulants; and included spironolactone and triamterene, which in the 2012 criteria had been listed in Tables 2 and 3, respectively. The creatinine clearance thresholds below which use of apixaban, edoxaban, and rivaroxaban are to be avoided are based on clinical trial exclusion criteria and may not be the same as

Table 2. 2015 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

Organ System, Therapeutic Category, Drugs	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Anticholinergics				
First-generation antihistamines Brompheniramine Carbinoxamine Chlorpheniramine Clemastine Cyproheptadine Dexbrompheniramine Dexchlorpheniramine Dimenhydrinate Diphenhydramine (oral) Doxylamine Hydroxyzine Meclizine Promethazine Triprolidine	Highly anticholinergic; clearance reduced with advanced age, and tolerance develops when used as hypnotic; risk of confusion, dry mouth, constipation, and other anticholinergic effects or toxicity Use of diphenhydramine in situations such as acute treatment of severe allergic reaction may be appropriate	Avoid	Moderate	Strong
Antiparkinsonian agents Benztropine (oral) Trihexyphenidyl	Not recommended for prevention of extrapyramidal symptoms with antipsychotics; more-effective agents available for treatment of Parkinson disease	Avoid	Moderate	Strong
Antispasmodics Atropine (excludes ophthalmic) Belladonna alkaloids Clidinium-Chlordiazepoxide Dicyclomine Hyoscyamine Propantheline Scopolamine	Highly anticholinergic, uncertain effectiveness	Avoid	Moderate	Strong
Antithrombotics				
Dipyridamole, oral short-acting (does not apply to the extended-release combination with aspirin)	May cause orthostatic hypotension; more effective alternatives available; intravenous form acceptable for use in cardiac stress testing	Avoid	Moderate	Strong
Ticlopidine	Safer, effective alternatives available	Avoid	Moderate	Strong
Anti-infective				
Nitrofurantoin	Potential for pulmonary toxicity, hepatoxicity, and peripheral neuropathy, especially with long-term use; safer alternatives available	Avoid in individuals with creatinine clearance <30 mL/min or for long-term suppression of bacteria	Low	Strong
Cardiovascular				
Peripheral alpha-1 blockers Doxazosin Prazosin Terazosin	High risk of orthostatic hypotension; not recommended as routine treatment for hypertension; alternative agents have superior risk–benefit profile	Avoid use as an antihypertensive	Moderate	Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drugs	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Central alpha blockers Clonidine Guanabenz Guanfacine Methyldopa Reserpine (>0.1 mg/d)	High risk of adverse CNS effects; may cause bradycardia and orthostatic hypotension; not recommended as routine treatment for hypertension	Avoid clonidine as first-line antihypertensive Avoid others as listed	Low	Strong
Disopyramide	Disopyramide is a potent negative inotrope and therefore may induce heart failure in older adults; strongly anticholinergic; other antiarrhythmic drugs preferred	Avoid	Low	Strong
Dronedarone	Worse outcomes have been reported in patients taking dronedarone who have permanent atrial fibrillation or severe or recently decompensated heart failure	Avoid in individuals with permanent atrial fibrillation or severe or recently decompensated heart failure	High	Strong
Digoxin	Use in atrial fibrillation: should not be used as a first-line agent in atrial fibrillation, because more-effective alternatives exist and it may be associated with increased mortality	Avoid as first-line therapy for atrial fibrillation	Atrial fibrillation: moderate	Atrial fibrillation: strong
	Use in heart failure: questionable effects on risk of hospitalization and may be associated with increased mortality in older adults with heart failure; in heart failure, higher dosages not associated with additional benefit and may increase risk of toxicity	Avoid as first-line therapy for heart failure	Heart failure: low	Heart failure: strong
	Decreased renal clearance of digoxin may lead to increased risk of toxic effects; further dose reduction may be necessary in patients with Stage 4 or 5 chronic kidney disease	If used for atrial fibrillation or heart failure, avoid dosages >0.125 mg/d	Dosage >0.125 mg/d: moderate	Dosage >0.125 mg/d: strong
Nifedipine, immediate release	Potential for hypotension; risk of precipitating myocardial ischemia	Avoid	High	Strong
Amiodarone	Amiodarone is effective for maintaining sinus rhythm but has greater toxicities than other antiarrhythmics used in atrial fibrillation; it may be reasonable first-line therapy in patients with concomitant heart failure or substantial left ventricular hypertrophy if rhythm control is preferred over rate control	Avoid amiodarone as first-line therapy for atrial fibrillation unless patient has heart failure or substantial left ventricular hypertrophy	High	Strong
Central nervous system				

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drugs	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Antidepressants, alone or in combination Amitriptyline Amoxapine Clomipramine Desipramine Doxepin >6 mg/d Imipramine Nortriptyline Paroxetine Protriptyline Trimipramine	Highly anticholinergic, sedating, and cause orthostatic hypotension; safety profile of low-dose doxepin (≤6 mg/d) comparable with that of placebo	Avoid	High	Strong
Antipsychotics, first- (conventional) and second- (atypical) generation	Increased risk of cerebrovascular accident (stroke) and greater rate of cognitive decline and mortality in persons with dementia Avoid antipsychotics for behavioral problems of dementia or delirium unless nonpharmacological options (e.g., behavioral interventions) have failed or are not possible ***and*** the older adult is threatening substantial harm to self or others	Avoid, except for schizophrenia, bipolar disorder, or short-term use as antiemetic during chemotherapy	Moderate	Strong
Barbiturates Amobarbital Butabarbital Butalbital Mephobarbital Pentobarbital Phenobarbital Secobarbital	High rate of physical dependence, tolerance to sleep benefits, greater risk of overdose at low dosages	Avoid	High	Strong
Benzodiazepines *Short- and intermediate- acting* Alprazolam Estazolam Lorazepam Oxazepam Temazepam Triazolam	Older adults have increased sensitivity to benzodiazepines and decreased metabolism of long-acting agents; in general, all benzodiazepines increase risk of cognitive impairment, delirium, falls, fractures, and motor vehicle crashes in older adults	Avoid	Moderate	Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drugs	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Long-acting Clorazepate Chlordiazepoxide (alone or in combination with amitriptyline or clidinium) Clonazepam Diazepam Flurazepam Quazepam	May be appropriate for seizure disorders, rapid eye movement sleep disorders, benzodiazepine withdrawal, ethanol withdrawal, severe generalized anxiety disorder, and periprocedural anesthesia			
Meprobamate	High rate of physical dependence; very sedating	Avoid	Moderate	Strong
Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics Eszopiclone Zolpidem Zaleplon	Benzodiazepine-receptor agonists have adverse events similar to those of benzodiazepines in older adults (e.g., delirium, falls, fractures); increased emergency department visits and hospitalizations; motor vehicle crashes; minimal improvement in sleep latency and duration	Avoid	Moderate	Strong
Ergoloid mesylates (dehydrogenated ergot alkaloids) Isoxsuprine	Lack of efficacy	Avoid	High	Strong
Endocrine				
Androgens Methyltestosterone Testosterone	Potential for cardiac problems; contraindicated in men with prostate cancer	Avoid unless indicated for confirmed hypogonadism with clinical symptoms	Moderate	Weak
Desiccated thyroid	Concerns about cardiac effects; safer alternatives available	Avoid	Low	Strong
Estrogens with or without progestins	Evidence of carcinogenic potential (breast and endometrium); lack of cardioprotective effect and cognitive protection in older women Evidence indicates that vaginal estrogens for the treatment of vaginal dryness are safe and effective; women with a history of breast cancer who do not respond to nonhormonal therapies are advised to discuss the risk and benefits of low-dose vaginal estrogen (dosages of estradiol <25 μg twice weekly) with their healthcare provider	Avoid oral and topical patch Vaginal cream or tablets: acceptable to use low-dose intravaginal estrogen for management of dyspareunia, lower urinary tract infections, and other vaginal symptoms	Oral and patch: high Vaginal cream or tablets: moderate	Oral and patch: strong Topical vaginal cream or tablets: weak
Growth hormone	Impact on body composition is small and associated with edema, arthralgia, carpal tunnel syndrome, gynecomastia, impaired fasting glucose	Avoid, except as hormone replacement after pituitary gland removal	High	Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drugs	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Insulin, sliding scale	Higher risk of hypoglycemia without improvement in hyperglycemia management regardless of care setting; refers to sole use of short- or rapid-acting insulins to manage or avoid hyperglycemia in absence of basal or long-acting insulin; does not apply to titration of basal insulin or use of additional short- or rapid-acting insulin in conjunction with scheduled insulin (i.e., correction insulin)	Avoid	Moderate	Strong
Megestrol	Minimal effect on weight; increases risk of thrombotic events and possibly death in older adults	Avoid	Moderate	Strong
Sulfonylureas, long-duration Chlorpropamide	Chlorpropamide: prolonged half-life in older adults; can cause prolonged hypoglycemia; causes syndrome of inappropriate antidiuretic hormone secretion	Avoid	High	Strong
Glyburide	Glyburide: higher risk of severe prolonged hypoglycemia in older adults			
Gastrointestinal				
Metoclopramide	Can cause extrapyramidal effects, including tardive dyskinesia; risk may be greater in frail older adults	Avoid, unless for gastroparesis	Moderate	Strong
Mineral oil, given orally	Potential for aspiration and adverse effects; safer alternatives available	Avoid	Moderate	Strong
Proton-pump inhibitors	Risk of *Clostridium difficile* infection and bone loss and fractures	Avoid scheduled use for >8 weeks unless for high-risk patients (e.g., oral corticosteroids or chronic NSAID use), erosive esophagitis, Barrett's esophagitis, pathological hypersecretory condition, or demonstrated need for maintenance treatment (e.g., due to failure of drug discontinuation trial or H_2 blockers)	High	Strong
Pain medications				
Meperidine	Not effective oral analgesic in dosages commonly used; may have higher risk of neurotoxicity, including delirium, than other opioids; safer alternatives available	Avoid, especially in individuals with chronic kidney disease	Moderate	Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drugs	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Non-cyclooxygenase-selective NSAIDs, oral: Aspirin >325 mg/d Diclofenac Diflunisal Etodolac Fenoprofen Ibuprofen Ketoprofen Meclofenamate Mefenamic acid Meloxicam Nabumetone Naproxen Oxaprozin Piroxicam Sulindac Tolmetin	Increased risk of gastrointestinal bleeding or peptic ulcer disease in high-risk groups, including those aged >75 or taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents; use of proton-pump inhibitor or misoprostol reduces but does not eliminate risk. Upper gastrointestinal ulcers, gross bleeding, or perforation caused by NSAIDs occur in approximately 1% of patients treated for 3–6 months and in ~2–4% of patients treated for 1 year; these trends continue with longer duration of use	Avoid chronic use, unless other alternatives are not effective and patient can take gastroprotective agent (proton-pump inhibitor or misoprostol)	Moderate	Strong
Indomethacin	Indomethacin is more likely than other NSAIDs to have adverse CNS effects. Of all the NSAIDs, indomethacin has the most adverse effects.	Avoid	Moderate	Strong
Ketorolac, includes parenteral	Increased risk of gastrointestinal bleeding, peptic ulcer disease, and acute kidney injury in older adults			
Pentazocine	Opioid analgesic that causes CNS adverse effects, including confusion and hallucinations, more commonly than other opioid analgesic drugs; is also a mixed agonist and antagonist; safer alternatives available	Avoid	Low	Strong
Skeletal muscle relaxants Carisoprodol Chlorzoxazone Cyclobenzaprine Metaxalone Methocarbamol Orphenadrine	Most muscle relaxants poorly tolerated by older adults because some have anticholinergic adverse effects, sedation, increased risk of fractures; effectiveness at dosages tolerated by older adults questionable	Avoid	Moderate	Strong
Genitourinary Desmopressin	High risk of hyponatremia; safer alternative treatments	Avoid for treatment of nocturia or nocturnal polyuria	Moderate	Strong

The primary target audience is practicing clinicians. The intentions of the criteria are to improve the selection of prescription drugs by clinicians and patients; evaluate patterns of drug use within populations; educate clinicians and patients on proper drug usage; and evaluate health-outcome, quality-of-care, cost, and utilization data.
CNS = central nervous system; NSAIDs = nonsteroidal anti-inflammatory drugs.

Table 3. 2015 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medication Use in Older Adults Due to Drug–Disease or Drug–Syndrome Interactions That May Exacerbate the Disease or Syndrome

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Cardiovascular					
Heart failure	NSAIDs and COX-2 inhibitors Nondihydropyridine CCBs (diltiazem, verapamil)—avoid only for heart failure with reduced ejection fraction Thiazolidinediones (pioglitazone, rosiglitazone) Cilostazol Dronedarone (severe or recently decompensated heart failure)	Potential to promote fluid retention and exacerbate heart failure	Avoid	NSAIDs: moderate CCBs: moderate Thiazolidinediones: high Cilostazol: low Dronedarone: high	Strong
Syncope	AChEIs Peripheral alpha-1 blockers Doxazosin Prazosin Terazosin Tertiary TCAs Chlorpromazine Thioridazine Olanzapine	Increases risk of orthostatic hypotension or bradycardia	Avoid	Peripheral alpha-1 blockers: high TCAs, AChEIs, antipsychotics: moderate	AChEIs, TCAs: strong Peripheral alpha-1 blockers, antipsychotics: weak
Central nervous system					
Chronic seizures or epilepsy	Bupropion Chlorpromazine Clozapine Maprotiline Olanzapine Thioridazine Thiothixene Tramadol	Lowers seizure threshold; may be acceptable in individuals with well-controlled seizures in whom alternative agents have not been effective	Avoid	Low	Strong
Delirium	Anticholinergics (see Table 7 for full list) Antipsychotics Benzodiazepines Chlorpromazine Corticosteroids[a] H_2-receptor antagonists Cimetidine Famotidine Nizatidine Ranitidine Meperidine Sedative hypnotics	Avoid in older adults with or at high risk of delirium because of the potential of inducing or worsening delirium Avoid antipsychotics for behavioral problems of dementia or delirium unless nonpharmacological options (e.g., behavioral interventions) have failed or are not possible ***and*** the older adult is threatening substantial harm to self or others Antipsychotics are associated with greater risk of cerebrovascular accident (stroke) and mortality in persons with dementia	Avoid	Moderate	Strong

(Continued)

Table 3 (Contd.)

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Dementia or cognitive impairment	Anticholinergics (see Table 7 for full list) Benzodiazepines H_2-receptor antagonists Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics Eszopiclone Zolpidem Zaleplon Antipsychotics, chronic and as-needed use	Avoid because of adverse CNS effects Avoid antipsychotics for behavioral problems of dementia or delirium unless nonpharmacological options (e.g., behavioral interventions) have failed or are not possible ***and*** the older adult is threatening substantial harm to self or others. Antipsychotics are associated with greater risk of cerebrovascular accident (stroke) and mortality in persons with dementia	Avoid	Moderate	Strong
History of falls or fractures	Anticonvulsants Antipsychotics Benzodiazepines Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics Eszopiclone Zaleplon Zolpidem TCAs SSRIs Opioids	May cause ataxia, impaired psychomotor function, syncope, additional falls; shorter-acting benzodiazepines are not safer than long-acting ones If one of the drugs must be used, consider reducing use of other CNS-active medications that increase risk of falls and fractures (i.e., anticonvulsants, opioid-receptor agonists, antipsychotics, antidepressants, benzodiazepine-receptor agonists, other sedatives and hypnotics) and implement other strategies to reduce fall risk	Avoid unless safer alternatives are not available; avoid anticonvulsants except for seizure and mood disorders Opioids: avoid, excludes pain management due to recent fractures or joint replacement	High Opioids: moderate	Strong Opioids: strong
Insomnia	Oral decongestants Pseudoephedrine Phenylephrine Stimulants Amphetamine Armodafinil Methylphenidate Modafinil Theobromines Theophylline Caffeine	CNS stimulant effects	Avoid	Moderate	Strong

(Continued)

Table 3 (Contd.)

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Parkinson disease	All antipsychotics (except aripiprazole, quetiapine, clozapine) Antiemetics Metoclopramide Prochlorperazine Promethazine	Dopamine-receptor antagonists with potential to worsen parkinsonian symptoms Quetiapine, aripiprazole, clozapine appear to be less likely to precipitate worsening of Parkinson disease	Avoid	Moderate	Strong
Gastrointestinal					
History of gastric or duodenal ulcers	Aspirin (>325 mg/d) Non-COX-2 selective NSAIDs	May exacerbate existing ulcers or cause new or additional ulcers	Avoid unless other alternatives are not effective and patient can take gastroprotective agent (i.e., proton-pump inhibitor or misoprostol)	Moderate	Strong
Kidney and urinary tract					
Chronic kidney disease Stages IV or less (creatinine clearance <30 mL/min)	NSAIDs (non-COX and COX-selective, oral and parenteral)	May increase risk of acute kidney injury and further decline of renal function	Avoid	Moderate	Strong
Urinary incontinence (all types) in women	Estrogen oral and transdermal (excludes intravaginal estrogen) Peripheral alpha-1 blockers Doxazosin Prazosin Terazosin	Aggravation of incontinence	Avoid in women	Estrogen: high Peripheral alpha-1 blockers: moderate	Estrogen: strong Peripheral alpha-1 blockers: strong
Lower urinary tract symptoms, benign prostatic hyperplasia	Strongly anticholinergic drugs, except antimuscarinics for urinary incontinence (see Table 7 for complete list)	May decrease urinary flow and cause urinary retention	Avoid in men	Moderate	Strong

The primary target audience is the practicing clinician. The intentions of the criteria are to improve selection of prescription drugs by clinicians and patients; evaluate patterns of drug use within populations; educate clinicians and patients on proper drug usage; and evaluate health-outcome, quality-of-care, cost, and utilization data.

[a] Excludes inhaled and topical forms. Oral and parenteral corticosteroids may be required for conditions such as exacerbations of chronic obstructive pulmonary disease but should be prescribed in the lowest effective dose and for the shortest possible duration.

CCB = calcium channel blocker; AChEI = acetylcholinesterase inhibitor; CNS = central nervous system; COX = cyclooxygenase; NSAID = nonsteroidal anti-inflammatory drug; SSRIs = selective serotonin reuptake inhibitors; TCA = tricyclic antidepressant.

Table 4. 2015 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medications to Be Used with Caution in Older Adults

Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Aspirin for primary prevention of cardiac events	Lack of evidence of benefit versus risk in adults aged ≥80	Use with caution in adults aged ≥80	Low	Strong
Dabigatran	Increased risk of gastrointestinal bleeding compared with warfarin and reported rates with other target-specific oral anticoagulants in adults aged ≥75; lack of evidence of efficacy and safety in individuals with CrCl <30 mL/min	Use with caution in in adults aged ≥75 and in patients with CrCl <30 mL/min	Moderate	Strong
Prasugrel	Increased risk of bleeding in older adults; benefit in highest-risk older adults (e.g., those with prior myocardial infarction or diabetes mellitus) may offset risk	Use with caution in adults aged ≥75	Moderate	Weak
Antipsychotics Diuretics Carbamazepine Carboplatin Cyclophosphamide Cisplatin Mirtazapine Oxcarbazepine SNRIs SSRIs TCAs Vincristine	May exacerbate or cause syndrome of inappropriate antidiuretic hormone secretion or hyponatremia; monitor sodium level closely when starting or changing dosages in older adults	Use with caution	Moderate	Strong
Vasodilators	May exacerbate episodes of syncope in individuals with history of syncope	Use with caution	Moderate	Weak

The primary target audience is the practicing clinician. The intentions of the criteria are to improve selection of prescription drugs by clinicians and patients; evaluate patterns of drug use within populations; educate clinicians and patients on proper drug usage; and evaluate health-outcome, quality-of-care, cost, and utilization data.

CrCl = creatinine clearance; SNRIs = serotonin-norepinephrine reuptake inhibitors; SSRIs = selective serotonin reuptake inhibitors; TCAs = tricyclic antidepressants.

those in their labeling. As with the drug–drug interaction table, this list is not meant to be comprehensive but to highlight potentially important but sometimes overlooked dose adjustments that are of particular concern for older adults. Anti-infective drugs were not included because the focus of the AGS Beers Criteria is on medications often employed for chronic use and because such information is available from multiple other sources (Table 6).

Drugs with Strong Anticholinergic Properties

Numerous scales are available to rank anticholinergic activity. The panel used a composite of several scales to draft Table 7, which provides an updated list of drugs with strong anticholinergic properties.[14 17] Investigators who developed the scales that the panel used in 2012 were asked whether any changes had been made, and the panel considered those. The most notable drug to be removed from the list was the second-generation antihistamine loratadine.

DISCUSSION

The 2015 AGS Beers Criteria for PIMs is the second such update by the American Geriatrics Society of medications to avoid in older adults and the fourth update of the criteria since their original release.[18 21] The criteria were first published in 1991, making them the longest-running criteria for PIMs in older adults. The process improves with each update. The literature search has become more targeted and refined, identifying new and important supporting evidence. The evidence review and grading methodology has been adjusted according to best practices and evolving approaches recommended by expert organizations. As in 2012, this resulted in some changes to the criteria in 2015, including drugs that were modified or dropped and a few new additions. The 2015 update introduced two new areas to improve drug safety in older adults: 1) drugs for which dose adjustment is required based on kidney impairment and 2) drug–drug interactions. Rather than create numerous individual caveats for each criterion excluding individuals in palliative care or hospice settings, the panel chose to exclude individuals in these settings from the criteria. The panel felt justified making this decision because of the shift in benefit-to-harm ratio in end-of-life decisions and paucity of evidence available for avoiding drugs in these populations.

Compared with the 2012 update, the 2015 update has fewer changes and new medications, likely because of the

Table 5. 2015 American Geriatrics Society Beers Criteria for Potentially Clinically Important Non-Anti-infective Drug–Drug Interactions That Should Be Avoided in Older Adults

Object Drug and Class	Interacting Drug and Class	Risk Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
ACEIs	Amiloride or triamterene	Increased risk of Hyperkalemia	Avoid routine use; reserve for patients with demonstrated hypokalemia while taking an ACEI	Moderate	Strong
Anticholinergic	Anticholinergic	Increased risk of Cognitive decline	Avoid, minimize number of anticholinergic drugs (Table 7)	Moderate	Strong
Antidepressants (i.e., TCAs and SSRIs)	≥2 other CNS-active drugs[a]	Increased risk of Falls	Avoid total of ≥3 CNS-active drugs[a]; minimize number of CNS-active drugs	Moderate	Strong
Antipsychotics	≥2 other CNS-active drugs[a]	Increased risk of Falls	Avoid total of ≥3 CNS-active drugs[a]; minimize number of CNS-active drugs	Moderate	Strong
Benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics	≥2 other CNS-active drugs[a]	Increased risk of Falls and fractures	Avoid total of ≥3 CNS-active drugs[a]; minimize number of CNS-active drugs	High	Strong
Corticosteroids, oral or parenteral	NSAIDs	Increased risk of Peptic ulcer disease or gastrointestinal bleeding	Avoid; if not possible, provide gastrointestinal protection	Moderate	Strong
Lithium	ACEIs	Increased risk of Lithium toxicity	Avoid, monitor lithium concentrations	Moderate	Strong
Lithium	Loop diuretics	Increased risk of Lithium toxicity	Avoid, monitor lithium concentrations	Moderate	Strong
Opioid receptor agonist analgesics	≥2 other CNS-active drugs[a]	Increased risk of Falls	Avoid total of ≥3 CNS-active drugs[a]; minimize number of CNS drugs	High	Strong
Peripheral Alpha-1 blockers	Loop diuretics	Increased risk of Urinary incontinence in older women	Avoid in older women, unless conditions warrant both drugs	Moderate	Strong
Theophylline	Cimetidine	Increased risk of Theophylline toxicity	Avoid	Moderate	Strong
Warfarin	Amiodarone	Increased risk of Bleeding	Avoid when possible; monitor international normalized ratio closely	Moderate	Strong
Warfarin	NSAIDs	Increased risk of Bleeding	Avoid when possible; if used together, monitor for bleeding closely	High	Strong

[a]Central nervous system (CNS)-active drugs: antipsychotics; benzodiazepines; nonbenzodiazepine, benzodiazepine receptor agonist hypnotics; tricyclic antidepressants (TCAs); selective serotonin reuptake inhibitors (SSRIs); and opioids.
ACEI = angiotensin-converting enzyme inhibitor; NSAID = nonsteroidal anti-inflammatory drug.

shorter time span since the criteria were last revised. Only three new medications and two new drug classes were added to Tables 2 or 3, although several were modified or had some changes to the rationale and recommendation statements. In a few instances, the level of evidence was revised based on new literature and the improved modified grading methodology. Some notable changes were the 90-day-use caveat being removed from nonbenzodiazepine, benzodiazepine receptor agonist hypnotics, resulting in an unambiguous "avoid" statement (without caveats) because of the increase in the evidence of harm in this area since the 2012 update.[22,23] In some cases, the rationale or wording of an avoid statement was modified or clarified because the panel and AGS had received comments regarding some confusion about a medication in the criteria. For example, the term "sliding scale" insulin was defined more clearly when referred to in the criteria. Other changes included lowering the creatinine clearance at which nitrofurantoin should be avoided to less than 30 mL/min from less than 60 mL/min. Also, removing Classes 1a, 1c, and III (with the exception of amiodarone) antiarrhythmic drugs as first-line treatment for atrial fibrillation. Constipation was removed as a drug–disease, drug–syndrome category, because this condition is common across the age spectrum and relevant drug–disease, drug–syndrome combinations to avoid are not predominantly specific to older adults.

Some other important additions in the 2015 update were the addition of long-term proton-pump inhibitor use in the absence of a strong indication because of risk of *C. difficile* infection, bone loss, and fractures and the addition of opioids in the diagnosis and condition table for older adults with a history of falls and fractures. If opioids must be used, it is recommended that reducing the use of other CNS-active medications be considered.[24,25] This statement is in recognition of the need to have adequate pain control while balancing the potential harms from opioids and untreated pain. The panel balanced the difficulty and challenges of poorly treated pain with the harms of opioids and available alternatives in older adults. Another critical change was to the language for use of antipsy-

Table 6. 2015 American Geriatrics Society Beers Criteria for Non-Anti-Infective Medications That Should Be Avoided or Have Their Dosage Reduced with Varying Levels of Kidney Function in Older Adults

Medication Class and Medication	Creatinine Clearance, mL/min, at Which Action Required	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Cardiovascular or hemostasis					
Amiloride	<30	Increased potassium, and decreased sodium	Avoid	Moderate	Strong
Apixaban	<25	Increased risk of bleeding	Avoid	Moderate	Strong
Dabigatran	<30	Increased risk of bleeding	Avoid	Moderate	Strong
Edoxaban	30–50	Increased risk of bleeding	Reduce dose	Moderate	Strong
	<30 or >95		Avoid		
Enoxaparin	<30	Increased risk of bleeding	Reduce dose	Moderate	Strong
Fondaparinux	<30	Increased risk of bleeding	Avoid	Moderate	Strong
Rivaroxaban	30–50	Increased risk of bleeding	Reduce dose	Moderate	Strong
	<30		Avoid		
Spironolactone	<30	Increased potassium	Avoid	Moderate	Strong
Triamterene	<30	Increased potassium, and decreased sodium	Avoid	Moderate	Strong
Central nervous system and analgesics					
Duloxetine	<30	Increased Gastrointestinal adverse effects (nausea, diarrhea)	Avoid	Moderate	Weak
Gabapentin	<60	CNS adverse effects	Reduce dose	Moderate	Strong
Levetiracetam	≤80	CNS adverse effects	Reduce dose	Moderate	Strong
Pregabalin	<60	CNS adverse effects	Reduce dose	Moderate	Strong
Tramadol	<30	CNS adverse effects	Immediate release: reduce dose Extended release: avoid	Low	Weak
Gastrointestinal					
Cimetidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Famotidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Nizatidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Ranitidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Hyperuricemia					
Colchicine	<30	Gastrointestinal, neuromuscular, bone marrow toxicity	Reduce dose; monitor for adverse effects	Moderate	Strong
Probenecid	<30	Loss of effectiveness	Avoid	Moderate	Strong

CNS = central nervous system.

chotics[26] in the dementia and delirium drug–disease, drug–syndrome category and the addition of avoiding antipsychotics in persons with delirium as first-line treatment. With increasing evidence of harm associated with antipsychotics[27,28] and conflicting evidence on their effectiveness in delirium and dementia, the rationale to avoid was modified to "avoid antipsychotics for behavioral problems unless nonpharmacological options (e.g., behavioral interventions) have failed or are not possible, ***and*** the older adult is threatening substantial harm to self or others."[7] The table of medications with strong anticholinergic properties has been updated. Anticholinergic burden and measurement is an area of literature that is continually evolving. Use of anticholinergic medications remains a concern because it is associated with impaired cognitive and physical function and risk of dementia.[29,30]

These criteria continue to be useful and necessary as a clinical and public health tool to improve medication safety in older adults and to increase awareness of polypharmacy and aid decision-making for choosing drugs to avoid in older adults. The AGS is publishing a companion piece to this update Beers Criteria; *How to Use the Beers Criteria—A Guide for Patients, Clinicians, Health Systems, and Payors*, published online in this journal. Recent work illustrates that prescription drug use has increased in older adults over the past 20 years, with poorer health in older adults associated with being on multiple medications.[31] Using data from the Medical Expenditure Panel Survey (MEPS), it was found that at least 41% of older adults still filled a prescription for a PIM in 2009–10 according to the 2012 AGS Beers Criteria. Even though the rate of PIM use declined from 45.5% in 2006–07 to 40.8% in 2009–10, almost half of older adults still filled a PIM presecription.[32] Despite their potential to increase the risk of falls, fractures, and cognitive impairment, the use of benzodiazepines remains high (~9%).[32,33]

The 2015 AGS Beers Criteria are an essential evidence-based tool to use in decision-making for drugs to avoid in older adults, but they are not meant to override clinical judgment or an individual's preferences, values, and needs. There may be cases in which the healthcare provider determines that a drug on the list is the only reasonable alternative or the individual is at the end of life or receiving palliative care. The criteria were developed in a

Table 7. Drugs with Strong Anticholinergic Properties

Antihistamines	Antiparkinsonian agents	Skeletal muscle relaxants
Brompheniramine	Benztropine	Cyclobenzaprine
Carbinoxamine	Trihexyphenidyl	Orphenadrine
Chlorpheniramine		
Clemastine		
Cyproheptadine		
Dexbrompheniramine		
Dexchlorpheniramine		
Dimenhydrinate		
Diphenhydramine (oral)		
Doxylamine		
Hydroxyzine		
Meclizine		
Triprolidine		
Antidepressants	Antipsychotics	Antiarrhythmic
Amitriptyline	Chlorpromazine	Disopyramide
Amoxapine	Clozapine	
Clomipramine	Loxapine	
Desipramine	Olanzapine	
Doxepin (>6 mg)	Perphenazine	
Imipramine	Thioridazine	
Nortriptyline	Trifluoperazine	
Paroxetine		
Protriptyline		
Trimipramine		
Antimuscarinics (urinary incontinence)	Antispasmodics	Antiemetic
Darifenacin	Atropine (excludes ophthalmic)	Prochlorperazine
Fesoterodine	Belladonna alkaloids	Promethazine
Flavoxate	Clidinium-chlordiazepoxide	
Oxybutynin	Dicyclomine	
Solifenacin	Homatropine (excludes ophthalmic)	
Tolterodine	Hyoscyamine	
Trospium	Propantheline	
	Scopolamine (excludes ophthalmic)	

Table 8. Medications Moved to Another Category or Modified Since 2012 Beers Criteria

Independent of Diagnoses or Condition (Table 2)	Considering Disease or Syndrome Interactions (Table 3)
Nitrofurantoin—recommendation and rationale modified	Heart failure—rationale and quality of evidence modified
Dronedarone—recommendation and rationale modified	Chronic seizures or epilepsy—quality of evidence modified
Digoxin—recommendation and rationale modified	Delirium—recommendation and rationale modified
Benzodiazepines—recommendation modified	Dementia or cognitive impairment—recommendation and rationale modified; new drugs added
Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics—recommendation modified	History of falls or fractures—recommendation and rationale modified; new drugs added
Meperidine—recommendation modified	Parkinson disease—recommendation and rationale modified
Indomethacin and ketorolac, includes parenteral—rationale modified	Chronic kidney disease Stage IV or less (creatinine clearance <30 mL/min)—triamterene moved to Tables 5 and 6
Antipsychotics—recommendation and rationale modified	Insomnia—new drugs added
Estrogen—recommendation modified	
Insulin, sliding scale—rationale modified	

Table 9. Medications Removed Since 2012 Beers Criteria

Independent of Diagnoses or Condition (Table 2)	Considering Disease and Syndrome Interactions (Table 3)
Antiarrhythmic drugs (Class 1a, 1c, III except amiodarone) as first-line treatment for atrial fibrillation	Chronic constipation—entire criterion
Trimethobenzamide	Lower urinary tract—inhaled anticholinergic drugs
Mesoridazine—no longer marketed in United States	
Chloral hydrate—no longer marketed in United States	

way that facilitates a team approach (physicians, nurses, pharmacists, therapists, and others) to prescribing and monitoring adverse effects.

The 2015 AGS Beers Criteria encourage the use of nonpharmacological approaches when needed to avoid drugs that have a high risk of causing an adverse event. The evidence base for specific nonpharmacological approaches using a person-centered approach to care is growing, especially in older adults and in persons with dementia and delirium.[34-36] A nonpharmacological toolkit for reducing antipsychotic use in older adults by promoting positive behavioral health, developed by investigators at The Pennsylvania State University and the Polisher Research Institute, was recently released. This toolkit can be accessed online (www.nursinghometoolkit.com). Nonpharmacological strategies for hospitalized older adults and their caregivers can also be accessed online (www.hospitalelderlifeprogram.org). A 2015 systematic review and meta-analysis of nonpharmacological strategies in older adults with delirium found that 11 of 14 studies demonstrated significant reductions in delirium incidence and a reduction in the rate of falls.[37] Several studies have also illustrated effective interventions to improve sleep.[38,39]

The AGS Beers Criteria are one component of a comprehensive approach to medication use in older adults, and they should be used in conjunction with other tools. The Screening Tool of Older Persons' potentially inappropriate Prescriptions (STOPP) and Screening Tool to Alert doctors to Right Treatment (START) criteria, first developed in 2008, are an explicit tool for assessing prescribing in older adults in Europe. They were updated in 2015 to include

Table 10. Medications Added Since 2012 Beers Criteria

Independent of Diagnoses or Condition (Table 2)	Considering Disease and Syndrome Interactions (Table 3)
Proton-pump inhibitors	Falls and fractures—opioids
Desmopressin	Insomnia—armodafinil and modafinil
Anticholinergics, first-generation antihistamines—meclizine	Dementia or cognitive impairment —eszopiclone and zaleplon
	Delirium—antipsychotics

drugs affecting or being affected by renal function, similar to this update of the AGS Beers Criteria.[40] Similar tools have been developed in Europe.[41] The current update of the AGS Beers Criteria confirms and extends this work with a rigorous independent evidence grading process, an open peer-review comment period consistent with Institute of Medicine standards, and the addition of drug–drug interactions and renal dose adjustment.

The 2015 AGS Beers Criteria have several important limitations. Older adults are often underrepresented in drug trials.[11,42] Thus, using an evidence-based approach may underestimate some drug-related problems or lead to weaker evidence grading. The GRADE process was used for evidence grading, which allowed for rigor and greater transparency in the evidence grading process.[10] The criteria cannot account for all individuals and special populations; for instance, they do not comprehensively address the needs of individuals receiving palliative and hospice care, in whom the balance of benefits and harms for many drugs on the list may differ from those of the general population of older adults. Finally, the search strategies used might have missed some studies published in languages other than English and studies available in unpublished technical reports, white papers, or other "gray literature" sources.

The process had many noteworthy strengths, including the use of a 13-member, geographically diverse interdisciplinary panel with ex-officio members from the Centers for Medicare and Medicaid Services, National Committee for Quality Assurance, and Pharmacy Quality Alliance; the use of an evidence-based approach using Institute of Medicine standards and independent grading of the evidence by panel members followed by a consensus approach; and the continued development of a partnership with AGS to update the criteria regularly.

In conclusion, the 2015 AGS Beers Criteria have several important updates, including the addition of new medications, clarification of some of the 2012 criteria language, the addition of selected drugs for which dose adjustment is required based on kidney impairment, and the addition of selected drug–drug interactions. Careful application of the criteria by healthcare professionals, consumers, payors, and health systems should lead to closer monitoring of drug use. Dissemination of the criteria should lead to increased education and awareness of drug-related problems, increased reporting of drug-related problems, active patient and caregiver engagement and communication regarding medication use, targeted interventions to decrease adverse drug events in older adults, and improved outcomes. Continued support from the AGS will allow for the criteria methodology and evidence for PIMs to be evaluated regularly and to remain up to date, relevant and valuable.

PANEL MEMBERS AND AFFILIATIONS

The following individuals were members of the AGS Panel to update the 2015 AGS Beers Criteria: Donna M. Fick, PhD, RN, FGSA, FAAN, College of Nursing and Medicine, The Pennsylvania State University, University Park, PA (co-chair); Todd P. Semla, PharmD, MS, BCPS, FCCP, AGSF, U.S. Department of Veterans Affairs National Pharmacy Benefits Management Services and Northwestern University Feinberg School of Medicine, Chicago, IL (co-chair); Judith Beizer, PharmD, CGP, FASCP, AGSF, St. Johns University, New York, NY; Nicole Brandt, PharmD, BCPP, CGP, University of Maryland, Baltimore, MD; Robert Dombrowski, PharmD, Centers for Medicare and Medicaid Services, Baltimore, MD (nonvoting member); Catherine E. DuBeau, MD, University of Massachusetts Medical School, Worcester, MA; Woody Eisenberg, MD, Pharmacy Quality Alliance, Inc., Baltimore, MD (nonvoting member); Jerome J. Epplin, MD, AGSF, Litchfield Family Practice Center, Litchfield, IL; Nina Flanagan, PhD, GNP-BC, APHM-BC, Decker School of Nursing, Binghamton University, Dunmore, PA; Erin Giovannetti, National Committee for Quality Assurance, Washington, DC (nonvoting member); Joseph Hanlon, PharmD, MS, BCPS, FASHP, FASCP, FGSA, AGSF, Department of Medicine (Geriatric Medicine) School of Medicine, University of Pittsburgh and Geriatric Research, Education and Clinical Center, Veterans Affairs Healthcare (GRECC) System, Pittsburgh, PA; Peter Hollmann, MD, AGSF, Alpert Medical School, Brown University, Providence, RI; Rosemary Laird, MD, MHSA, AGSF, Geriatric Medical Leader for Florida Hospital, Winter Park, FL; Sunny Linnebur, PharmD, FCCP, BCPS, CGP, Skaggs School of Pharmacy and Pharmaceutical Sciences, University of Colorado, Aurora, CO; Satinderpal Sandhu, MD, Summa Health Care System and Northeast Ohio Medical University, Akron, OH; Michael Steinman, MD, University of California at San Francisco and San Francisco Veterans Affairs Medical Center, San Francisco, CA.

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APPENDIX F:

PATIENT/MRN SHEET

PATIENT/MRN SHEET

APPENDIX G:

MEDICATION RECONCILIATION STATISTICS

Number of high-risk medications found in retrospective chart review	Number of high-risk medications found on admission post educational intervention
2	2
3	2
7	4
3	4
7	5
6	4
2	2
2	1
1	2
1	1
3	2
0	2
5	3
3	3
4	2
4	3
0	2
4	3
5	2
2	3
3	3
2	2
2	2
1	2
0	2
3	2
3	2
4	2
4	2
1	2
Total: 87	Total: 73

Mean: .46667
Standard deviation: 1.43198
df = 29

Critical value: 3.396
t = 1.785

APPENDIX H:

PRE-TEST/POST-TEST SCORES

PROVIDER	PRE-TEST	POST-TEST
Provider 1	7	7
Provider 2	8	8
Provider 3	8	8
Provider 4	9	9
Provider 5	9	9
Provider 6	8	8
Provider 7	8	8
Provider 8	8	8
Provider 9	8	8
Provider 10	9	9

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